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DIAGNOSIS & TREATMENT IN DISEASES OF THE LUNGS

FRANK E. TYLECOTE
AND
GEORGE FLETCHER

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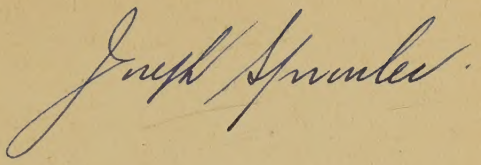

DIAGNOSIS & TREATMENT
IN
DISEASES OF THE LUNGS

OXFORD MEDICAL PUBLICATIONS

DIAGNOSIS & TREATMENT IN DISEASES OF THE LUNGS

BY

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PREFACE

THIS book aims at placing before the senior student or the young practitioner the ordinary methods of diagnosis and treatment of the commoner forms of lung disease in such a manner as to prove helpful to him in practice. Special attention has been given to the errors which are likely to beset him in dealing with the more important affections, and this may excuse a certain amount of repetition. To keep the book within small compass we have omitted any formal account of the pathology of the various conditions. This also explains the absence of detailed references to the various authorities whose writings we have had occasion to consult.

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8 St. John Street,
Manchester, *October* 1927.

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DIAGNOSIS & TREATMENT
IN
DISEASES OF THE LUNGS

CHAPTER I

THE LUNGS IN HEALTH AND DISEASE

I. ANATOMICAL CONSIDERATIONS

THE lungs are protected by the bony cage of the thorax, of which they occupy the greater part. Each lung is invested by its pleural sac, the visceral layer of which moves freely over the parietal layer during respiration, so that the sac is merely a potential cavity. The attachment of the lung to the mediastinal septum is formed by the root of the lung and, below this, by the broad pulmonary ligament. The two lungs differ in shape. Owing to the presence of the liver the right dome of the diaphragm is at a higher level than the left, and the right lung is therefore the shorter of the two, while the fact that the heart is not mesial in position but deviates towards the left, makes the left lung the narrower. On their parietal surfaces the lungs are in apposition with the vertebræ, ribs, and sternum ; on their mesial aspect with the

heart, great vessels, pericardium, trachea, and œsophagus; and, on their basal aspect, with the diaphragm. Each lung is roughly pyriform in shape, and is made up of innumerable air-cells arranged in lobules round the branches of the bronchial tree. To this fact is due the characteristically spongy feel of lung tissue in bulk. The supporting structure of the lungs consists of fine septa of fibrous tissue continuous with that under the pleura. Along these septa run the bronchi, the pulmonary vessels, and the lymphatics.

The apex of each lung rises to about one inch above the level of the middle of the clavicle. From that point the anterior border runs downwards and inwards behind the sterno-clavicular joint, and closely approaches the corresponding border of the opposite lung at the level of the second costal cartilage. On the right side the lung border descends vertically to the level of the sixth costal cartilage, and then sweeps outwards round the thorax to reach the vertebral column at the level of the tenth dorsal spine, crossing the eighth rib in the mid-axillary line. On the left side the anterior margin runs down to the fourth costal cartilage, whence it deviates outwards and downwards towards the cardiac apex, round which it curves inwards. It then descends for a short distance, and runs outwards at a somewhat lower level than the corresponding border of the right lung. It is important to remember that while there is practically no difference between the limits of lung and pleura in the upper zones of the chest, the parietal

pleura at the base of the thorax descends to a considerably lower level than the lung, the difference being about two inches in the mammary line, four inches in the mid-axillary line, and one and a half inches in the scapular line.

Lobes of the Lung.—Each lung is divided by a fissure which, beginning at the level of the second dorsal spine, sweeps downwards and forwards round the chest to meet the lower border of the lung at the sixth costal cartilage. This fissure marks the lower limit of the upper lobe on each side. In addition, the right lung has a transverse fissure beginning at the fourth costal cartilage and passing outwards almost horizontally to meet the oblique fissure in the mid-axillary line.

Thus, while the left lung has two lobes, upper and lower, the right lung has three—upper, middle, and lower. It should be noted that the front of the chest largely represents the upper lobes, and the back of the chest below the level of the second dorsal spine, the lower lobes, of the lung. On the right side the middle lobe is accessible in front below the level of the fourth rib and quickly tapers off towards the axilla ; posteriorly it does not show at all.

Trachea, Bronchi, and Air-Cells.—The bifurcation of the trachea is opposite the lower border of the manubrium sterni, and at the level of the fourth dorsal vertebra. Here it divides into right and left bronchi, of which the former is the wider and the shorter. The angle of bifurcation is usually less than a right angle, and the direction of

the two main bronchial stems is downwards and backwards. About an inch from the trachea the right bronchus gives off the eparterial bronchus, for the right upper lobe. In the substance of the lung branches are given off from the two main bronchial stems, which thus gradually diminish in calibre. The small tube entering a pulmonary lobule is called a bronchiole or lobular bronchial tube. Here air-cells or alveoli begin to appear upon its wall in increasing numbers, so that its cylindrical shape is lost. To such an enlarged and irregular bronchiole the term atrium or alveolar passage is applied, and from this atrium are given off infundibula. Alveoli closely cluster round both atria and infundibula. As the bronchial tubes lessen in size the cartilage in their walls gradually disappears, though it is said to persist until the diameter of the tube is about one-fiftieth of an inch. While there are thus no cartilaginous laminæ in the walls of the intralobular bronchioles, their muscular coat is well developed, but, as the tube progressively narrows, the muscular tissue also gradually diminishes, though it is said still to be discernible even in the infundibula. The alveolar wall is formed of a layer of cells resting upon fine connective and elastic tissue in which the pulmonary capillaries ramify. As the bronchial branches lessen in size the lining epithelium alters in character, the columnar ciliated epithelium of the larger tubes being gradually replaced by cubical epithelium and finally by pavement epithelium, which alone is found in the infundibula and alveoli.

The **roots of the lungs** lie on either side of the

vertebral column from the fifth to the seventh dorsal spines. Each root is enveloped by the reflection of its pleura, and contains in its areolar tissue certain important structures, namely, the pulmonary veins, the pulmonary artery, and the bronchus with the bronchial vessels, in order from before backwards. From above downwards the order on the right side is bronchus, pulmonary artery, pulmonary veins; on the left, pulmonary artery, bronchus, pulmonary veins. This difference is due not to the presence on the right side of the eparterial bronchus, but to the fact that on the left side the bronchus passes under the arch of the aorta. The root of the lung also contains the bronchial vessels, bronchial glands, lymphatics, and the pulmonary nerve plexuses.

It will be recalled that the lung, including the bronchi and bronchial glands, is supplied by the bronchial arteries arising from the thoracic aorta. The blood thus supplied returns for the most part by the bronchial veins, though some part enters the pulmonary veins through capillary anastomosis between the two sets of vessels.

Lymphatics. — The superficial pulmonary lymphatic vessels lie immediately beneath the pleura and extend along the pulmonary septa. The deep lymphatics accompany the blood vessels running along the bronchi. These two sets communicate with each other, and all the pulmonary lymphatics terminate in the bronchial glands at the roots of the lungs. From these glands efferent vessels arise, some passing directly to the thoracic duct and others to the tracheal

glands through which they communicate with the deep lymphatic glands of the neck, eventually reaching the thoracic duct on the left side and the right lymphatic duct on the right. The lymphatics arise from the visceral pleura, the bronchial mucous membrane, and the walls of the alveoli. The free intercommunication of these lymphatics provides for the absorption of fluid and fine particles. There are tiny openings called stomata between the lymph vessels and the bronchi and alveoli. During the act of respiration these stomata dilate and contract, and this movement, together with the action of the valves of the lymphatics, sends a continuous stream of lymph and débris from the periphery to the root of the lung. It should be noted that the lymphatics of the pleural and peritoneal surfaces of the diaphragm communicate with each other.

The **nerve supply** of the lung is derived from the vagus and sympathetic, which take part in the formation of the anterior and posterior pulmonary plexuses, so named from their relation to the root of the lung. Branches from these plexuses accompany the bronchi and the vessels into the lung substance. The vagus is believed to supply the circular muscular fibres in the bronchial tree.

Surface Anatomy of the Chest.—For convenience of description the following terms are commonly applied to various areas of the surface of the chest.

Anteriorly on each side the clavicle separates the *supraclavicular* from the *infraclavicular* region. Below these lie the *mammary* and the *inframammary*

regions. Above the suprasternal notch and overlying the trachea is the *suprasternal* region, the sternum itself being divided into *superior* and *inferior* halves at the level of the third costal cartilage. Posteriorly on each side the spine of the scapula divides the *supraspinous* from the *infraspinous* region, while the region between the scapula and the spinal column is known as the *interscapular*. Below the level of the scapular angle is the *infrascapular* region, or the *base*. Laterally, the sixth rib separates the *upper axillary* from the *lower axillary* region.

As aids to localisation the following vertical lines are usually recognised. The *mid-sternal* line and on either side of it the *lateral sternal* line, which passes down the border of the sternum : the *parasternal* line, lying between the *lateral sternal* line and the *nipple* (or *mid-clavicular*) line. On the lateral aspect the *anterior* and *posterior axillary* lines mark respectively the anterior and posterior limits of the axilla, which is bisected by the *mid-axillary* line. The *posterior scapular* line is that of the vertebral border of the scapula, while the *vertebral* line corresponds to the spinous processes of the vertebræ.

II. PHYSICAL EXAMINATION OF THE CHEST

This comprises inspection, palpation, percussion, and auscultation, which are often supplemented by other measures, such as cyrtometry and radiography.

Inspection.—Inspection of the chest should

never be omitted, and should be conducted in good light, and with the patient stripped to the waist. Failure to do this will, sooner or later, lead the practitioner into humiliating errors. The position to be adopted by the patient will be determined by his general condition and comfort, as well as by the convenience of the physician. Any abnormality in the general shape of the chest should be noted.

General Deformities.—Of such general deformities certain types are commonly recognised :

1. The *rachitic* chest. This deformity develops in children who have suffered from rickets. The chest wall yields at its weakest point, in the region of the costo-sternal junction, thus causing a more or less vertical hollow on either side of the sternum and at some distance from it, so that the sternal region itself projects unduly forward. The costo-sternal junctions are abnormally prominent, and by their beaded appearance form the so-called *rickety rosary*, which usually disappears before puberty. *Harrison's sulcus* is the name given to a hollow passing outwards and slightly downwards from the xiphisternal region. It corresponds in position to the attachment of the diaphragm, but is found only on the anterior surface of the chest. Below this sulcus the costal margin is slightly everted. This is due in part to the presence of the sulcus and in part to the resistance of the abdominal viscera, which moreover are frequently enlarged in rickets.

Rickety kyphosis or scoliosis may also give rise

to asymmetry of the chest. As a rule deformities of the chest due to rickets tend to disappear as the general health improves.

2. The *pigeon* chest. This is the result of obstruction to air entry during childhood. The curve of the ribs, anterior to their angles, is straightened out, so that the sternum projects like a keel, and the transverse section of the thorax approximates to a triangle. Well-marked cases of pigeon chest usually show a distinct Harrison's sulcus.

3. The *phthinoid* chest. Here the thorax is long and narrow, the ribs are more vertical than normal, and the subcostal angle is small. The vertebral borders of the scapulæ stand out from the chest wall like wings (the *alar* chest). Usually also, the antero-posterior diameter is diminished (the *flat* chest). It should be remembered that the presence of the phthinoid chest does not necessarily imply the presence of lung disease.

4. The *emphysematous* chest. In this all the diameters are increased so that the general appearance is barrel-shaped. The ribs are more horizontal than usual, some degree of kyphosis is commonly present, and the angle of Louis, at the junction of the manubrium with the body of the sternum, is unusually prominent.

Unilateral Deformities of the Chest.—These may take the form of enlargement or shrinking. Enlargement may be due to pleural effusion, pneumothorax, or compensatory emphysema. Diminution or shrinking usually results from chronic disease of the lungs such as tuberculosis or pleural thickening.

It is also seen with pulmonary collapse following obstruction of a large bronchus.

Local Deformities of the Chest Wall.—Local enlargements may be due to aneurysm, tumour, abscess, or bony abnormality; while local depressions may arise from chronic pleurisy, pulmonary collapse, or congenital deficiency of a muscle. During inspection the presence of old scars resulting from empyemata or wounds should also be noted, and the condition of the glands of the neck and axilla should not be overlooked. In some chests a funnel-shaped depression is found in the lower sternal region. It is often the result of respiratory obstruction in childhood, though it is said to arise in adults as a result of prolonged local pressure during work, *e.g.*, in cobblers.

A permanent record of the character and degree of chest deformity is obtained by the use of the *cyrtometer*. This instrument consists of two strips of lead joined by a hinge of rubber tubing. It is sometimes graduated in inches or centimetres. The hinge is placed over the spinal column, and the lead strips closely applied round the chest. The resultant curve is transferred to a sheet of paper.

Inspection may reveal undue local prominence or distension of the superficial veins, which may result from increased intrathoracic pressure, due, *e.g.*, to growth or aneurysm. Where the skin is unusually thin, the veins in general are easily seen. Along the line of attachment of the diaphragm the skin may present a row of dilated venules, which, as a rule, is of no diagnostic significance. In the

region of the last cervical and upper two or three dorsal spines a group of distended venules may often be found. They are believed by some writers to be due to inflammation of the apical pleura, and therefore to be indicative of disease of the apex, but, as they are often seen in healthy people, too much diagnostic weight should not be attached to them.

The *degree of expansion* of the chest during inspiration should always be noted, and if necessary confirmed by measurement. In the male adult the difference between full expiration and full inspiration varies from 1 to 5 inches, the circumference of the chest being taken at the level of the nipples. An expansion of less than $1\frac{1}{2}$ inch suggests some degree of respiratory insufficiency, and anything under 2 inches is looked upon with suspicion by examiners for life assurance. Local deficiencies of expansion should be sought for. In early phthisis the affected apex may show relatively poor expansion, while chronic pleural thickening or collapse may visibly impair the expansion of some part of the lung. In young children with grave obstruction to respiration, recession of the epigastrium, the lower zone of the chest wall, and the supraclavicular fossæ is often observed during inspiration. This phenomenon is less marked in the more rigid chests of adults.

Paralysis of the diaphragm is a rare condition, which is usually overlooked. Exaggeration of the thoracic movements accompanied by relative immobility and inspiratory recession of the upper

abdominal muscles should lead one to suspect its presence, which, if the patient is not too ill, can be confirmed by X-ray screening, which reveals a raised and relatively immobile diaphragm. In the still rarer condition of paralysis of the intercostals alone there is marked diminution of the thoracic movement during inspiration.

Respiratory Movements.—In the adult the normal rate of breathing is about eighteen per minute, the pulse respiration ratio being four to one. In children the breath-rate is higher, and in young infants it is about forty per minute. The respiratory movement has two elements, the costal and the abdominal; the former predominates in women, the latter in men and young children. Increase of the respiration rate is found in febrile conditions, and in the majority of dyspnœas such as those secondary to diseases of the lungs, the heart, the blood, and the kidneys. It should be noted that increase of the breath-rate (polypnœa) and laboured breathing (dyspnœa) do not always go hand in hand. Hysteria, for instance, may cause a much increased breath-rate without any obvious difficulty in breathing, while in asthma extreme dyspnœa is often accompanied by a low breath-rate. Decreased respiratory rate may be found in certain comas, such as those due to uræmia, diabetes, narcotic poisoning, and the grosser cerebral lesions. Respiration may be irregular in rhythm. In the adult expiration immediately follows inspiration, and is succeeded by a pause, but in young children, especially when they are suffering from respiratory

embarrassment, the cycle is often different, the pause occurring between inspiration and expiration, so that the child holds its breath for a more or less lengthy period—the *inverse* type of respiration. In laryngeal obstruction or spasm inspiration may be unduly prolonged, while the expiratory movement is prolonged in emphysema and asthma. A peculiar form of disordered respiration, known as *Cheyne-Stokes breathing*, is sometimes found in advanced kidney or cardiovascular disease. A period of apnœa, lasting up to half a minute, is followed by a series of respirations gradually increasing both in rate and depth to a maximum, after which they become gradually slower and shallower, until the apnœic interval is reached. Usually the cycle is complete in a minute or so. Cheyne-Stokes breathing may be found in healthy dwellers at high altitudes and sometimes in normal children during sleep. In meningitis and in encephalitis lethargica the respirations, while regular in depth and rate, may be found to occur in groups separated by an interval of apnœa. This *grouped* breathing is sometimes known as *Biot's breathing*, and it also may occur in some healthy subjects during sleep. A modification of respiration known as *air hunger* may be met with in diabetic coma and other conditions associated with ketosis. Both inspiration and expiration are abnormally prolonged, so that the respirations are slow, deep, and "sighing" in character.

Palpation.—In palpation we confirm by touch the results of inspection as regards the shape and

movements of the chest. By this means we also determine the presence of local tenderness, fluctuation, or pulsation. It enables us to compare the vocal and tussive fremitus over both lungs, and to detect the presence of abnormal fremitus due to friction or rhonchi. Of these its most valuable function is probably the investigation of *vocal fremitus*, by which is meant the vibration of the chest wall caused by the spoken voice. The patient is asked to repeat some such words as "Ninety-nine." The deeper the pitch of the voice the more easily is the fremitus elicited, so that palpation is a more useful procedure in men than in women and children. In children it is often best determined when the child is crying. Increase of vocal fremitus is found in consolidation, provided the bronchi be patent, and over large cavities near the surface of the lung. It is diminished in fat or muscular subjects, in some cases where the pleura is much thickened, or where there is definite fluid or gas in the pleural cavity. Palpation should always be used to confirm or to determine the position of the apex beat of the heart, as this is one of the most important landmarks in the clinical examination of the chest.

Percussion is of two kinds, direct and indirect. In the former the percussing finger strikes the actual surface of the body, as, for instance, when the percussion notes of the two apices are compared by directly striking the clavicle. In the latter the blow is delivered on a finger of the other hand—the so-called pleximeter finger, which must be closely applied to the chest wall. Nowadays

the instruments known as percussion hammers (plessors) and pleximeters are rarely employed. Opinions differ as to the best method of percussion, but, by actual practice, every one will find the method best suited to himself. Generally speaking, a light tapping movement is the most effective, but where the chest covering is thick, as in muscular subjects or over the scapula, the percussion should be heavier, and not infrequently a heavy "follow-through" stroke will decide a doubtful finding. The movement of the percussing hand should involve the wrist and metacarpo-phalangeal joints only, the elbow and shoulder joints remaining fixed. By percussion we determine the borders of the lungs and their relation to the neighbouring viscera. The pleximeter finger should travel from the more to the less resonant viscus and should lie parallel to the border of the latter. As in other methods of physical examination of the chest comparison should be made between the corresponding parts of the two lungs. The note over healthy lung is usually described as clear or resonant. It should be remembered, however, that a normal note is different in different patients. Thus the note obtained with a fat or muscular subject would strike one as abnormal if found over an emaciated chest. Normally the percussion resonance is best heard in the infraclavicular and upper axillary regions. The note is less resonant over the scapular region behind. It is modified also in the neighbourhood of the heart, liver, and stomach. *Traube's space* is the name given to the

semilunar area of the chest wall which directly overlies a portion of the stomach, and over which the note is tympanitic in quality. Its borders are the left lobe of the liver, the lower border of the left lung, the spleen, and the lower left costal margin anteriorly. In disease the percussion resonance may be increased or diminished. Increased resonance is found in emphysema, general or compensatory. Over a pneumothorax the resonance is increased and is usually somewhat tympanitic or drum-like in character. A large cavity near the surface also yields a hyper-resonant note. Above the level of a pleural effusion or of a pneumonic consolidation the note is often hyper-resonant and somewhat tympanitic, the so-called *Skodaic* resonance. Diminution of resonance is found over consolidated lung, intrathoracic tumours, pleural thickening or effusion. It may be apparent as a mere heightening of the pitch, or it may amount to a stony dulness such as is found over a large pleural effusion. In addition to the altered percussion note heard over a diseased lung, a sense of undue resistance may be experienced by the fingers during percussion. This is especially marked over a massive pleural exudate ; it is also found over a new growth underlying the chest wall. With pneumonic consolidation, on the other hand, the dull percussion note is usually accompanied by a sense of resilience.

Special names have been applied to certain percussion phenomena associated with cavitation :

1. The cracked-pot sound (*Bruit de pot fêlé*).—This

may be obtained by heavy percussion over a cavity which is in direct communication with a bronchus. It is best heard during expiration, and when the patient's mouth is open. It is like the hissing chink made by striking the knee with the two hands clasped crosswise, and thus expelling the enclosed air from the cavity so formed. It is best heard over thin-walled chests. It may also be obtained in a healthy child when it is crying. Occasionally it is found in the neighbourhood of a pneumonic area, or above the level of an effusion.

2. *Wintrich's Phenomenon* is the term applied to the raising of the pitch of the percussion note over a cavity when the patient opens his mouth.

3. *Gerhardt's Phenomenon* is the alteration in percussion note over a cavity due to change in the position of the patient. It probably results from a displacement of fluid, with consequent alteration in the shape of the cavity.

4. The bell sound, or *bruit d'airain*, may be found over a large cavity, but is typically heard over a pneumothorax. One coin placed flat on the chest is tapped by another, and the sound conveyed to the auscultating ear has a bell-like quality.

Nowadays the clinical diagnosis of cavitation is made with less confidence than formerly, since the skiagram not infrequently fails to corroborate what may seem definite signs of a vomica.

Auscultation.—Auscultation may be direct, when the ear is applied to the chest wall, or indirect, when the stethoscope is employed. The patient's chest should be stripped, and he should assume an

easy attitude, with his muscles relaxed. He should be instructed to breathe "in and out through the mouth," regularly and deeply, but not noisily.

During auscultation we investigate :

i. The character of the breath sounds, and the relation of the respiratory phases.

ii. The presence of adventitious sounds.

iii. The vocal resonance, *i.e.*, the transmission of the spoken and whispered voice.

i. Character of the Breath Sounds.—When we apply a stethoscope to the chest wall over the lungs we hear the sounds produced at the glottis as modified by their passage through the lung tissues. These sounds are heard with least modification over the trachea as the so-called *tracheal* breathing. Over the fourth dorsal spine they are heard with slight alteration, and here they constitute typical *bronchial* breathing. Such bronchial breathing has certain features : (*a*) inspiration and expiration are equal in duration and in intensity ; (*b*) there is a distinct interval between these two phases ; (*c*) the breath-sounds have a characteristically hollow, guttural *ch* quality. Certain varieties of bronchial breathing are recognised. Over a large cavity bronchial breathing of a low pitch may be heard, and this is known as *cavernous* breathing. Where disease has produced a communication between a bronchus and a cavity the breath-sounds may resemble those produced by blowing across the mouth of a bottle, and this variety of bronchial breathing is therefore sometimes called *amphoric* ; it is very similar to cavernous breathing, but has a

somewhat musical, metallic quality. In a pneumonic lung the glottic sounds are well transmitted by the consolidated tissue, and auscultation reveals a high-pitched bronchial breathing to which the term *tubular* is applied. Over the greater part of the healthy adult chest the respiratory murmur has the character known as *vesicular*. It is typically heard in the infraclavicular region. In this—the normal respiratory murmur—the expiratory phase is heard to be shorter than the inspiratory ; there is no interval between these two phases, and as compared with bronchial breathing the sounds are soft and rustling in character and of a lower pitch. *Broncho-vesicular* or *indeterminate* breathing is a variety intermediate between the bronchial and the vesicular. It may be heard normally over the back of the chest near the root of the lung. The expiratory phase is prolonged, there may be a short pause between the two phases, but the typical quality of bronchial breathing is lacking. In disease, broncho-vesicular breath-sounds may be found where comparatively healthy lung overlies a more deeply placed consolidation, as in some cases of pneumonia. Various modifications of vesicular breathing are met with. The respiratory murmur may be increased in intensity ; in the chests of healthy children, for instance, the breath-sounds are distinctly harsher than in adults—so-called *puerile* breathing. In adults such harsh breathing usually indicates something pathological. Diminution of the respiratory murmur is common in early pneumonia and is an important sign in incipient

phthisis. The diminution may amount to complete abolition of the respiratory murmur in cases of massive effusion, dense pleural thickening, intra-thoracic tumour or aneurysm, and in some cases of early pneumonia when the bronchial tubes are blocked. A modification of vesicular breathing which affects only inspiration is that known as *jerky*, *cogwheel*, or *interrupted* breathing. It has usually no significance, but it sometimes results from deficient expansion of the lung tissue and may therefore be found as a localised sign in early tuberculosis.

The expiratory element in vesicular respiration is sometimes heard to be unduly prolonged. This phenomenon may be found in diseases like asthma and emphysema, where the expiratory movement of the chest wall occupies a longer time than usual. It is also common in certain phases of pneumonia and tuberculosis where the respiratory murmur tends to approximate to the bronchial in type.

ii. Adventitious Sounds heard during auscultation may arise in the pleural cavity or in the lung. *Pleuritic friction* is produced by the rubbing together of the two inflamed and roughened pleural surfaces, and is most likely to be audible at the end of inspiration and the beginning of expiration. The friction sound may be heard only on deep breathing, and is usually loudest in the axilla or at the base. It varies much in degree, from a fine, hair-like rustle to a loud, leathery creak. It strikes the ear as being superficial in origin, though when it is fine in quality it may be differentiated only with difficulty from intrapulmonary crepitations.

Adventitious sounds of intrapulmonary origin are commonly classified as *râles* and *rhonchi*. The former are moist sounds and the latter dry, but it must be noted that these terms do not indicate their mode of production, but rather the impression made upon the observer's ear. Râles are usually classified as large, medium, and small. Large râles are coarse and bubbling in character. They may be formed in the larger bronchi as in bronchitis, or in the cavities of tubercle, bronchiectasis, or pulmonary abscess. Medium crackling râles are heard over softening tuberculous areas, and in a resolving pneumonia they form the *redux crepitation*. Fine râles or crepitations are heard in the early stages of pneumonia, in incipient phthisis, in miliary tuberculosis of the lungs, and in pulmonary œdema or congestion from any cause. The finest râle is the crepitation of pneumonia ; it is purely inspiratory. The crepitation of early phthisis is predominantly inspiratory. The *consonating râle* is somewhat larger than a crepitation, and has a definite pitch and a resonant quality. It is often met with below the clavicle over a breaking-down tuberculous focus. The effect of the act of coughing upon râles should always be noted. In purely bronchitic conditions it may lead to their disappearance, but, when consolidation is present, the râles are usually increased in number or may be heard for the first time with the inspiration which follows the cough. Where a cavity is in communication with a bronchus, such a post-tussive inspiration may be marked by a muffled hissing sound, the so-called *post-tussive suction*.

Rhonchi are sonorous or snoring and sibilant or whistling. The former are produced in the larger tubes, the latter in the smaller, while in the medium-sized tubes rhonchi of an intermediate pitch are formed. Rhonchi may occur with inspiration, or with expiration, or with both. Those produced in the larger tubes may be felt by the palpating hand—*rhonchal fremitus*, or heard at a distance of several feet from the patient. One characteristic of rhonchi is their variability. Even in the same patient they may vary from time to time in number, site, and pitch. They are the characteristic auscultatory sign of bronchitis, but are also found in asthma, while widespread small piping rhonchi may be the only sounds heard in acute miliary tuberculosis of the lungs. Localisation and persistence of rhonchi, especially over an upper lobe, should always raise the suspicion of tuberculosis, while a solitary, localised and persistent rhonchus, usually of low pitch, not infrequently indicates pressure upon a bronchus by aneurysm or growth. In bronchitic conditions of the chest rhonchi are often accompanied by râles, and indeed in the capillary bronchitis of children, râles and not rhonchi may be the most striking feature. The same statement is true of certain cases of chronic bronchitis in old people where the smaller tubes are affected.

iii. Vocal Resonance is investigated by auscultating while the patient repeats deliberately some such words as " ninety-nine " or " one, two, three." Increase of vocal resonance is commonly found over consolidation and over a cavity, provided the area

involved is not too small. Marked increase of vocal resonance is known as *bronchophony*. Where the speech or whisper is heard as definitely articulate words the condition is known as *pectoriloquy*. Diminution of vocal resonance may be found normally where the voice is weak or the chest covering thick. It is markedly diminished where fluid or gas is present in the pleural cavity. Some impairment of vocal resonance is also found in emphysema, in pulmonary œdema, and in so-called massive pneumonia where the bronchi are blocked. By itself, the investigation of vocal resonance must be regarded as of secondary importance. Apart from disease, the resonance is modified by the age, sex, and build of a patient. Exquisite whispering pectoriloquy, such as one commonly associates with a large cavity, may be found over a consolidated lung. *Ægophony* is the term used to describe the tremulous bleating character of the voice which is typically heard posteriorly about the upper level of the fluid in some cases of pleural effusion.

The Peculiarities of the Normal Chest.—Errors in diagnosis not infrequently arise from failure to recognise the limits of the normal in the examination of the chest.

The upper lobe of the right lung differs from that of the left in several respects. In many normal chests it yields a relatively dull percussion note, some increase of vocal fremitus and vocal resonance, and a respiratory murmur of a harsh quality somewhat approaching the bronchial in type. It is still too common a mistake to diagnose pulmonary

tuberculosis from these physiological peculiarities. Not infrequently, on auscultating healthy subjects, we meet with râles in the axillary region and at the base, and during the first deep inspirations fine crackles may be heard above and below the clavicle and along the sternal border : almost invariably these sounds disappear after coughing or when the lungs have been fully expanded. In some normal chests there is a slight reduction of the respiratory murmur over the right base, and when the patient bends forwards the alteration in the position of the liver may cause some dulling of the percussion note in the same region. In a child's chest, above the level of the heart, the great vessels may give rise to dulness, extending for more than a finger's breadth to the left of the sternal border. This dulness is sometimes appreciable in adults also.

CHAPTER II

BRONCHITIS

BRONCHITIS is one of the commonest and most important diseases met with in medical practice in this country, and is responsible for a large amount of incapacity and for many deaths. In England and Wales it causes more deaths than pulmonary tuberculosis, the respective figures for 1925 being 35,252 and 32,382. Its incidence varies in different parts of the country, being particularly heavy in Lancashire. Winter and spring are the seasons of prevalence.

Ætiological Factors.—Among the predisposing causes must be mentioned bad climatic conditions, especially such as involve sudden changes of temperature, dampness, and a foggy or smoke-laden atmosphere ; heredity and the extremes of life ; and certain pre-existing diseases such as heart disease, nephritis, gout, and, in the young, rickets. Sedentary occupations, notably those in which the workers are exposed to sudden temperature changes, are prone to provoke and maintain a catarrhal condition of the bronchial mucosa ; dusty trades, such as mining or stone-cutting ; irritant fumes, as in gassing in civil and military life ; dampness in the

dwelling-house or in the subsoil, are also causally associated with bronchitis. In the individual, septic conditions of the mouth or naso-pharynx, nasal obstruction with consequent mouth-breathing, and excess in alcohol or tobacco, often play an important part. Acute bronchitis is a common symptom of influenza, enteric fever, measles, and whooping-cough. In many children dentition is accompanied by transient bronchitis.

Bacteriology.—No one organism is constantly present. The pneumococcus, the micrococcus catarrhalis, the bacillus influenzæ, and the streptococcus are most frequently met with. The part played by bacteria in the causation of bronchitis is not constant. In influenzal bronchitis, for instance, infection is largely responsible for the catarrh of the bronchial tubes, but in bronchitis following "gassing," bacterial agency must, in the first instance, be a minor factor, at any rate where the symptoms develop immediately after exposure to an irritant.

Bronchitis is usually classified as acute and chronic, though several varieties of the latter are commonly recognised.

ACUTE BRONCHITIS

Symptoms and Signs.—As a rule acute bronchitis begins with the symptoms of a febrile cold, and often follows an ordinary cold in the head, the inflammation spreading downwards from the upper respiratory tract. The temperature is usually raised, but is rarely high. The patient complains of irritation

behind the sternum, tightness of the chest, and frequent dry cough. There may be some degree of hoarseness as a result of laryngitis. The sputum on its first appearance is scanty and mucoid. It soon becomes more abundant in quantity, frothy, muco-purulent, later even purulent. Where the trachea is principally involved, a sense of tightness, followed by a burning raw sensation, is complained of in the region of the suprasternal notch, and the act of coughing is very painful. Such an acute tracheitis or tracheo-bronchitis is not uncommon in some cases of influenza, and a very severe type of it was found in cases of gassing during the Great War. In an otherwise healthy adult the more marked symptoms subside in about a week, by which time the cough has become easier and looser and the sputum more purulent.

In uncomplicated acute bronchitis the prognosis is good, but in children and in the aged the inflammation often extends to the bronchioles, causing capillary bronchitis or broncho-pneumonia ; when this occurs there is marked dyspnœa with cyanosis, and the patient becomes gravely ill.

The respiration rate is but slightly increased, except where the smaller tubes are involved. Palpation may reveal rhonchal fremitus. Percussion is normal. The characteristic signs are found on auscultation, and consist of rhonchi. These are predominantly expiratory, but may also accompany inspiration. Where the larger tubes are involved, the rhonchi are sonorous in character, but, where the smaller are affected, they are smaller

and of a high pitch. Not uncommonly rhonchi of both kinds can be heard several feet from the patient. As a rule the rhonchi of acute bronchitis are equally distributed over both lungs ; it occasionally happens, however, that they are more marked in one lung than in the other, or they may specially affect one portion of one lung only. In some cases of acute bronchitis moist râles may be heard in the later stages of the attack, especially over the bases. As this indicates that the secretion is gravitating to the smaller tubes it is not as a rule a good sign ; but in children medium-sized râles may be the main auscultatory evidence of bronchitis throughout the attack, and no such inference need be drawn. In uncomplicated acute bronchitis there is no diagnostic alteration in the character of the heart sounds.

Diagnosis.—This rests upon the mode of onset, the nature of the subjective symptoms, and the character of the auscultatory signs. It should be remembered that at a stage when the trachea alone is involved, auscultation is usually negative, and this may lead the physician to underestimate the very real suffering of his patient. Above all one should not overlook the possibility that the bronchitis may be symptomatic of an acute disorder, such as enteric fever or influenza, or a complication of some chronic condition, such as valvular disease of the heart, nephritis, or gout. Where the adventitious sounds are localised or unduly persistent, especially over an upper lobe or in the region of a root, the possibility of tuberculosis of the lungs or of the bronchial glands should always be considered, and

the sputum examined bacteriologically, though such cases are not necessarily tuberculous. In children and in elderly people such patches of bronchitis are not uncommon and are usually basal in distribution.

CHRONIC BRONCHITIS

Chronic bronchitis may follow one attack, or more commonly repeated attacks, of acute bronchitis, or it may develop gradually in association with a condition of debility due to faulty environment, constitutional disease, unhealthy habits, or increasing age. In children it is often associated with naso-pharyngeal inflammation or obstruction, especially when mouth-breathing ensues, or it may follow rickets, measles, or whooping-cough. Climatic conditions have much to do with the persistence of a bronchial catarrh. In the individual patient the symptoms vary with the season, being more severe during the winter and spring months and becoming less troublesome in the summer. In the earlier stages of the disease indeed there may be no symptoms during summer, and the only complaint may be that of winter cough.

Symptoms and Signs.—The symptoms of chronic bronchitis are those of bronchial catarrh with some degree of emphysema. Cough is a constant feature. It is usually worse in the morning, and may be severe enough to cause giddiness, retching, or even vomiting. On retiring to bed the patient may suffer an exacerbation of cough probably due to his having left a room of warmer temperature.

After the morning bout of coughing, which clears the accumulated secretion from the tubes, he is relatively comfortable for the rest of the day, especially in the earlier stages of the disease. When the malady is firmly established or when the weather is changeable, damp, or foggy, some degree of cough and dyspnœa is always present. When the accompanying emphysema is marked, the dyspnœa may be paroxysmal in character and may simulate asthma. True asthma, however, is usually absent and the dyspnœa is due to a paroxysm of coughing in an effort to clear the bronchial tubes. The sputum is typically mucopurulent or purulent, and varies enormously in amount. In long-established cases it is generally abundant. Sometimes it is definitely nummular, a fact which occasionally leads to an erroneous diagnosis of phthisis. The degree of dyspnœa varies ; where emphysema is marked it is constant and considerable, while it is also increased during an acute exacerbation of the disease, and in unfavourable weather. As compared with acute bronchitis there is no particular complaint of pain, but in the mornings there is a feeling of tightness and discomfort in the chest, until this is relieved by cough and expectoration. Impairment of nutrition is not a constant feature ; indeed many of the worst sufferers are fat and flabby, but, in older patients, especially those with cardio-vascular degeneration, there may be marked loss of weight, so that the presence of tuberculosis is suspected.

The signs are those of bronchial catarrh and

emphysema. The chest is unduly distended, and the respiratory excursion is shallow. The respiration rate is increased. In some cases the percussion note is hyper-resonant, though in shrunken senile patients it may be somewhat impaired. On auscultation expiration is heard to be prolonged, and is accompanied by rhonchi, sonorous or sibilant in character. These may also be heard during inspiration, though to a less degree, while bubbling râles of various sizes may accompany both phases of respiration, especially over the bases. As a result of the strain on the right side of the heart there is often some degree of enlargement of the right ventricle, though this may not be demonstrable on physical examination owing to the presence of emphysema. The second pulmonic sound may be accentuated.

Varieties of Bronchitis.—The term *dry catarrh*, or *bronchitis sicca*, is used to describe cases in which the sputum, if any, is scanty, pearly, or pellet-like in character, the adventitious sounds few or absent, but the cough troublesome and often paroxysmal. *Bronchorrhœa*, on the other hand, is characterised by very abundant expectoration, in some cases watery, in others thinly purulent, amounting perhaps to several pints a day. *Putrid bronchitis*, though sometimes described as a separate variety, is usually found to be chronic bronchitis associated with some degree of bronchiectasis. *Fibrinous bronchitis* is a rare condition in which casts of the bronchial tubes are expelled after paroxysms of dyspnœa and coughing. The patient

commonly suffers from chronic bronchitis. Hæmoptysis, usually slight, may accompany the expulsion of the cast. All these varieties of chronic bronchitis are rare.

Diagnosis.—As a rule the diagnosis of chronic bronchitis is easy, being based upon the appearance of the patient and the nature of his symptoms and signs. We must make sure that the bronchitis is the only affection, and not merely a symptom of underlying disease. Special attention therefore should be paid to the examination of the heart, the urine, and the blood pressure. It should also be remembered that persistent rhonchi may be caused by pressure from aneurysm or intrathoracic growth. When the rhonchi are localised and persistent, especially over an upper lobe, the question of tubercle should be raised, the more so if there is evidence of decline in general health or of a prolonged pyrexia. This possibility should also be considered when a winter cough persists into the summer months, and is accompanied by progressive debility and some degree of fever.

X-ray examination is of little positive service in the diagnosis of bronchitis. In chronic cases the skiagram may show accentuated bronchial and root shadows. Where the condition is secondary to heart disease the increase in these shadows may be very striking, and some alteration in the cardiac contour is usually apparent. In dealing with cases of bronchitis generally the most valuable function of the skiagram is to assure us of the absence of graver conditions, such as tuberculosis, neoplasm, or aneurysm.

Prognosis.—In acute bronchitis the prognosis is good in uncomplicated cases, but at the extremes of life, when the smaller bronchioles are involved, the condition is a serious one, and in old age may be so apart from any capillary bronchitis. Where acute bronchitis accompanies such diseases as enteric fever, influenza, pneumonia, heart failure, or renal disease, the prognosis of the primary disease may have to be qualified according to the severity of the bronchial inflammation. In the prognosis of chronic bronchitis much depends upon the financial position of the patient, and his ability to change his occupation and habits, and, if need be, his surroundings. In cases where the condition has persisted for years and where only palliative treatment is possible, death, as a rule, eventually results from heart failure or broncho-pneumonia.

TREATMENT OF ACUTE BRONCHITIS

The patient should be put to bed in a well-ventilated room, kept at a uniform temperature of 65° F. An open fire is probably the most satisfactory method of heating. If the cough is very irritable the air may be kept moist by a bronchitis kettle with a long spout, around which, if the patient is a child, a steam tent may be erected. The steam from the kettle may be medicated with Friar's balsam (1 drachm to a pint of water), or an earthenware inhaler may be used. A convenient alternative is a vaporiser containing cresol preparations—a form of treatment which is also useful in some cases of fibrinous bronchitis. An initial purge, grey powder

for children and calomel for adults, should never be omitted, while a hot bath, or even a hot mustard foot-bath, given at the beginning of the attack, often affords much relief. A linseed poultice several times repeated, a mustard plaster, or a hot fomentation, may be applied to the front of the chest when there is much substernal rawness. For this discomfort and for the sense of constriction which often accompanies it, antiphlogistine or a stimulant liniment, such as lin. camph. co., may be similarly employed. In children the use of heavy poultices is to be deprecated, and a cotton-wool or gamgee jacket is to be preferred. Nasal breathing should be encouraged. Weak, debilitated patients should not be kept in one position too long. For an adult a 10 grain Dover's powder is good initial treatment, though this does not apply to cases where there is cyanosis, or to children. Hot drinks such as lemonade, gruel, tea, or whisky punch, according to the taste of the patient, as well as a largely fluid diet, are helpful by promoting the action of the skin and by hastening the period when, owing to increased tracheo-bronchial secretion, the discomfort becomes less. The diet should be given in small quantities every two to three hours, except during sleep. A quart of milk, perhaps diluted with soda or barley-water, should be taken daily, and should be supplemented by light milk foods, beef-tea, and chicken broth. In debilitated patients eggs beaten up in milk, white soups, and malted milk may be usefully added. As the temperature falls and the appetite improves, boiled eggs, boiled fish, chicken, and farinaceous

puddings can be allowed, and a return to normal diet should thereafter be gradually made, according to the progress of the patient. In gouty, fat, or plethoric patients the diet should be less liberal, and indeed may require to be definitely restricted, special attention being paid to the limitation of alcoholic beverages, and water being partly substituted for milk in the preparation of the so-called milk foods.

In the early stages our aim is to promote secretion, and for this purpose a diaphoretic mixture should be prescribed :

℞ Pot. citrat., gr. xv.
Vin. ipecac., ℥ x.
Liq. ammon. acetat., dr. i.
Aq. chlorof., ad ½ oz.
Every four hours

for an adult; to this may be added tr. camph. co., ℥ xv., if the cough is troublesome. For a child the dose should be proportionately diminished or the following substituted :

℞ Vin. ipecac., ℥ v.
Spt. æth. nitros., ℥ v.
Tr. camph. co., ℥ v.
Syrup, ℥ xv.
Aq. chlorof., ad dr. i.
Every three hours.

When the secretion is looser, a stimulating expectorant mixture is indicated :

℞ Ammon. carb., gr. v.
Vin. ipecac., ℥ x.
Tr. scillæ, ℥ x.
Inf. senegæ, ad ½ oz,
Three times a day after meals.

Attention should be paid to the bowels throughout the attack. After the earlier stages are over, local applications to the chest should be discontinued and warm cotton-wool or thermogene-wool substituted. If the cough is paroxysmal we may add tr. belladonna in ℥ v. doses to the expectorant prescription given above. If it prevents sleep, certain additional measures are called for. Before using any further preparation containing opium or its derivatives, glycerine pastilles or a drink of hot glycerine and water may be given, or Brompton lozenges may be tried. Failing these, a linctus may be prescribed, such as elixir heroin c. terpin co. (B.P.C.), in 1 drachm doses; or an evening dose of the Christison's mixture of the Edinburgh pharmacopœia, the formula being:

℞ Tr. opii ammon.
Tr. lavand. co.
Syr. scillæ, aa, ℥ xx.
Syr. simplic., ℥ xl.
Aq. menth. pip., ad oz. i.

When convalescence is tedious a tonic mixture, such as 1 drachm of Easton's syrup in 1 oz. chloroform water thrice daily after meals, may be given. In such cases also a change of air is usually beneficial, and is imperative where the chest condition threatens to become chronic. This is a point which is often overlooked in practice—a fact which tends greatly to increase the numbers of chronic bronchitics. The question as to when the patient should return to work is often of importance, and in deciding this we ought to consider the time of the

year, his age and general condition, his freedom from symptoms and physical signs of the disease, and the nature of his occupation.

TREATMENT OF CHRONIC BRONCHITIS

Here we place more reliance on hygiene than on drugs. All the details of the patient's life should come under review. Special attention should be paid to dampness in his home and bedroom, and the question of adequate ventilation and heating should also be raised. He should be careful to avoid colds, and to this end he should wear light and warm clothing. He should avoid overheated and badly ventilated rooms and changes from one atmosphere to another of lower temperature. During the day his feet should be kept warm and dry, and at night he should take care that his sleeping-suit and bed-clothes are free from dampness. The bedroom should not be overheated, as too dry an atmosphere may provoke troublesome coughing. Regular exercise in the open air should be encouraged if the weather is at all suitable, but undue exposure should be avoided. If the patient's occupation involves work in a dusty or fume-laden atmosphere it may be necessary for him to change it to one more healthy. Excess in alcohol or tobacco must be forbidden, and in some cases the use of these luxuries must be expressly prohibited. Local conditions of the nose and throat such as tend to originate catarrh or to favour mouth-breathing should be dealt with, and oral sepsis should be sought for and treated if found. Artificial dentures should be kept

scrupulously clean. Smoke, whether at home or elsewhere, should, as far as possible, be avoided ; *e.g.*, if the patient travels much by train, he should travel in a non-smoking compartment. The diet in the majority of cases should be generous and be rich in fat. This may be supplied as butter or cream, or cod-liver oil may be prescribed with good results. Late heavy suppers should be forbidden, and the chief meal should be taken in the middle of the day.

Constipation should be avoided. It should not be forgotten that many bronchitics are too fat, and such cases often find marked benefit when their weight is reduced by restriction in diet and increased exercise. Some such patients are gouty or alcoholic.

If, in spite of these measures, together with appropriate drug treatment, the condition persists, the patient should be advised to change his residence to some healthier locality, if his means permit. Generally speaking, a district free from smoke and fog and with a dry, non-clayey soil should be chosen. In England certain resorts have a reputation in the treatment of chronic bronchitis. Bournemouth and Torquay on the South Coast are among the most favoured. On the West Coast, Colwyn Bay and Penmaenmawr are often suitable, while the Blackpool and Cleveleys air agrees with many, especially with post-influenzal cases. Southport, Lytham, and Grange-over-Sands are suitable for less robust patients and for children, and the same statement applies to Broadstairs on the Kentish coast. Many inland resorts will also be found beneficial, *e.g.*,

the Malverns. Farther afield, the South of France, Madeira, and Egypt have similar reputations in the treatment of chronic bronchitis. The ordered life of a spa, such as Harrogate, may be indicated in some cases.

Acute exacerbations of the chest condition should be treated as acute bronchitis, and the patient should be instructed to remain at home and in bed when he catches cold or develops a temperature. Speaking generally, chronic bronchitics are well advised to remain indoors in the evenings and during foggy or otherwise unsuitable weather. Those who are permitted to go out at night should wear respirators. While rest in bed is often a useful temporary measure in such patients, it should not be forgotten, in dealing with old people, that prolonged recumbency may lead to circulatory weakness and consequent pulmonary hypostasis. In the management of cases of acute or chronic bronchitis in which the chest condition is secondary to some underlying disorder, the treatment of the primary condition should never be neglected.

Drug Treatment.—This may be either general or symptomatic. We have already pointed out the value of cod-liver oil in the treatment of many cases of chronic bronchitis. A good petroleum emulsion sometimes proves very serviceable. Easton's syrup, or a mixture containing small doses of potassium iodide with liquor arsenicalis may be usefully given for a period of several weeks. For some patients syrup of the iodide of iron is a convenient preparation.

℞ Potass. iod., gr. v.
Liq. arsenicalis, ♏ iii.
Tr. nucis vom., ♏ x.
Ferri et ammon. cit., gr. v.
Aq. chlor., ad i oz. t.d.s., p.c.

The troublesome morning cough due to the accumulation of muco-pus in the tubes overnight may be alleviated by a hot drink (*e.g.*, tea from a thermos flask) taken before getting out of bed in the morning. This measure is also useful when sleep is broken by cough during the night. The cough, which is often so troublesome when the patient retires to bed, may be lessened by attention to the measures recommended above, though it often demands a sedative draught. The following formula may be found suitable for occasional use :

Tr. chlor. et morph. co., B.P. 1885, ♏ v.
Codein., gr. $\frac{1}{12}$.
Syr. chloral, $\frac{1}{2}$ dr.
Syr. pruni virg., ♏ xx.
Aq. chlor., ad $\frac{1}{2}$ oz. p.r.n.

Where some degree of spasm is present, a stimulating antispasmodic mixture such as the following is often serviceable :

℞ Sp. ammon. aromat., ♏ x.
Sp. chlorof., ♏ x.
Tr. cardam. co., ♏ x.
Æther pur., ♏ viii.
Sp. vini rectif., ♏ v.
Aq., ad $\frac{1}{2}$ oz. p.r.n.

Where the sputum is tenacious, or where some degree of emphysema or asthma is present, the addition of potassium iodide to a stimulating

expectorant mixture will often prove of service. A useful formula is as follows :

℞ Ammon. carb., gr. v.
Potass. iod., gr. v.
Tr. scillæ, ℥ x.
Tr. nucis vom., ℥ vii.
Inf. senegæ, ad ½ oz. t.d.s., p.c.

Gouty patients sometimes respond well to 10 ℥ doses of vin. colchici added to this mixture for a period, while those with some degree of cardiac insufficiency may require 7 to 10 ℥ doses of tinct. digitalis as a temporary addition.

In prescribing for cases of chronic bronchitis one must beware of the routine use of such formulæ as those given above. The drugs should be chosen to suit the special features of the individual case, and, when chosen, should be given in adequate doses. A diluted stock mixture which, when examined in detail, is found to contain 1 ℥ doses of tincture of digitalis or 1 grain doses of ammonium carbonate, can hardly be expected to have much effect. Drug treatment should not be continued longer than is absolutely necessary, and attention to the respiratory system should not lead one to neglect the alimentary, renal, and skin functions. On occasion indeed it may be advisable to suspend for a time the administration of all expectorant and sedative drugs, and to substitute a simple stomachic mixture containing nux vomica, bicarbonate of soda, and gentian, *e.g.* :

℞ Sodii bicarb., gr. vii.
Tr. nucis vom., ℥ vii.
Inf. gent. co., ad ½ oz. t.d.s., p.c.

Other forms of treatment, such as stimulant applications to the chest—*e.g.*, camphorated oil, turpentine liniment, lin. camph. co., or chilli paste—have a certain value. Steam inhalations of terebene, creosote, or Friar's balsam may relieve an irritating cough or diminish spasm, and the same applies to inhalations of drugs such as creosote from the sponge of a Burney Yeo's (Squire's) inhaler. Useful formulæ are :

℞ Ol. pini sylvestr., ½ dr.
Lin. terebinth. acetic., ad 2 oz.
M ft. lin.
Sig. to be rubbed in over the chest as directed.

℞ Creosot., 1 dr.
Ol. eucalypt., 1 dr.
Sp. chlorof., 2 drs.
Tereben., ad 1 oz.
Ft. vapor.
Sig. 15 drops on the pad of a Yeo's inhaler.
To be inhaled from time to time as directed.

Vaccine Treatment.—In the prophylaxis of bronchitis vaccine treatment is sometimes successful. It is now the custom in certain institutions and boarding-schools to give two, or sometimes three, doses of a stock vaccine at the beginning of the winter, and the chest-diseases incidence rate in these places has certainly diminished since this has been done. Autogenous vaccine treatment will also be found useful in certain cases of recurrent or obstinate bronchitis. The dosage varies with the nature of the vaccine.

CHAPTER III

BRONCHIECTASIS—FOREIGN BODIES IN THE AIR-PASSAGES

BRONCHIECTASIS

DILATATION of the bronchi is always secondary to some other lung condition.

Ætiology and Pathology.—The factors are three:

i. Weakening of the bronchial walls as the result of pre-existing disease.

ii. Increased air pressure in the bronchial tubes due to the expiratory efforts of coughing.

iii. Undue tension on, or constriction of, the bronchial tubes, in fibrotic or neoplastic conditions of the thorax. Such conditions may cause dilatation directly, or they may act indirectly by producing narrowing of the lumen with subsequent dilatation on the distal side.

The clinical conditions with which bronchiectasis is associated are many. Among the commoner are chronic bronchitis and chronic fibrotic processes in the lungs, such as sometimes follow upon lobar or lobular pneumonia, pulmonary tuberculosis, pleurisy, and empyema. Among the rarer conditions are foreign bodies in the air-passages,

syphilitic bronchial stenosis, and pressure upon the bronchial tubes by aneurysm, neoplasm, or hydatid cyst.

Dilatation of the bronchial tubes is of two kinds, *cylindrical* and *saccular*. The cylindrical is the more common, though the less often diagnosed during life, the symptoms and signs being those of chronic bronchitis. It may involve a small portion of the bronchial tree, or the majority of the tubes of one or both sides. Saccular bronchiectasis consists of a more or less globular dilatation of a restricted portion of the bronchial tube. Its size depends upon the tube involved, and varies from that of a pea to that of an orange. *Bronchiolectasis*, or dilatation of the smaller bronchial tubes, occurs in children, and may be either acute or chronic. It cannot be diagnosed with certainty during life, as its presence is usually obscured by the signs and symptoms of the primary condition, *e.g.*, bronchopneumonia or bronchitis. Post mortem, taking all forms of bronchiectasis together, both lungs are found to be affected in about half the cases. Clinically, however, where the physical signs permit of a diagnosis being made, *i.e.*, in the saccular form, the characteristic signs are usually found over one lung only, and are almost always basal, though not infrequently adventitious sounds are heard over the other base.

Symptoms and Signs.—In many cases, especially of the cylindrical variety, the symptoms are merely those of chronic bronchitis, while in others the presence of the bronchiectasis is overshadowed by

the primary disease, *e.g.*, tuberculosis, aneurysm, or new growth. In a well-established case of the saccular variety the symptoms are characteristic. The chief complaints are of cough and expectoration. The cough usually comes on in paroxysms, and results in the rapid expectoration of large quantities of purulent sputum. Between the paroxysms the patient is fairly comfortable. The sputum is distinctive. It is large in amount, up to a pint or more a day, and is raised in a very short period of time. As the disease progresses it increases in amount, and usually becomes fœtid in character. This fœtor is also found in the patient's breath, and may be marked enough to pervade the whole room. In some cases the fœtor varies in degree from time to time. The sputum, on standing, separates into three layers, the upper frothy, the middle mucoid, the lower pus-containing and granular. Microscopically this sediment is found to contain pus cells, fatty acid crystals, Charcot-Leyden crystals, and small yellowish bodies with a very offensive odour, the so-called Dittrich's plugs. Hæmoptysis is not the rule, but is often met with, occasionally in large amount. The general condition of the patient varies ; as a rule it shows little deterioration. When there is much septic absorption, or when the condition is markedly progressive, there may be much constitutional disturbance, and the patient then looks ill and sallow. There is often distinct cyanosis, most noticeable about the lips. Clubbing of the ends of the fingers and toes, with perhaps some swelling

of the tip of the nose, is very common and of considerable diagnostic importance. The swelling involves only the soft tissues over the terminal phalanges. Fully developed *hypertrophic pulmonary osteo-arthropathy* is rare, and is characterised by hypertrophy of the metacarpal and metatarsal bones, and of the adjacent ends of the bones of the forearm and leg. Dyspnœa is usually present in some degree, and depends rather upon the presence of bronchitis and emphysema than upon the actual bronchial dilatation. As a rule there is no fever.

In many cases of bronchiectasis there are no physical signs apart from those of the condition to which the bronchiectasis is secondary. In well-developed saccular bronchiectasis the physical signs may be distinctive. Where much fibrosis is present, inspection reveals some flattening and retraction of the affected side, and the heart may be seen and felt to be displaced towards that side. There is more or less impairment of the percussion note. The auscultatory findings characteristically vary with the condition of the cavity. When the cavity is full, the respiratory murmur is diminished and the adventitious sounds are relatively few. When it has been emptied, the breathing is bronchial or amphoric and is accompanied by râles which vary in character according to the size of the cavity. In some cases the signs of a primary lung condition will also be found on physical examination.

Complications.—Many cases of bronchiectasis, especially of the cylindrical variety, are prone to

recurrent attacks of bronchitis, usually accompanied by some degree of pyrexia. Pyrexia may also be due to septic absorption from the secretion in large cavities. Septic complications are not uncommon, and are usually serious. They include pneumonia, pulmonary abscess, gangrene of the lung, pleurisy, and cerebral abscess. Other septic complications are rarer—septicæmia, pyæmia, pericarditis. Amyloid disease may develop.

Diagnosis.—This is based upon the presence of one of the primary causes of bronchiectasis, the paroxysmal nature of the cough, the fœtor of the breath and sputum, and the physical signs when these are present. In all obscure cases the question of a foreign body in a bronchus should be considered. The condition may be further investigated by a skiagram, though this often fails to reveal the extent of the bronchiectasis. Lipiodol, injected intratracheally either through the ordinary intratracheal syringe, or by direct puncture through the crico-thyroid membrane, has been employed to demonstrate in the skiagram the full extent of the bronchial dilatation. Where the general health is impaired, bronchiectasis may simulate pulmonary tuberculosis. But the temperature chart, the sputum examination, and the fact that bronchiectasis is generally, and tuberculosis rarely, basal, should prevent error. Abscess and gangrene of the lung may be differentiated from bronchiectasis by the fact that they are acute conditions, usually accompanied by grave constitutional disturbance.

Rupture of an empyema into a bronchus may

produce many of the signs and symptoms of a bronchiectasis; but with such an escaping empyema the onset of copious expectoration is sudden, there is usually a preceding history of pneumonia or influenza, often recent, and recovery is frequently rapid. The sudden appearance of several ounces of purulent sputum in a case where physical signs and expectoration have previously been absent, commonly means the rupture of an interlobar empyema into a bronchus, and no further symptoms may occur.

Prognosis.—Slight degrees of bronchiectasis or bronchiolectasis following whooping-cough or measles in young children may be recovered from. One has also seen recoveries where the condition has developed as a complication of post-anæsthetic broncho-pneumonia in young adults. As a rule, however, the disease is incurable, and sooner or later death results, usually from one of the complications mentioned above. Under treatment the general and chest symptoms may improve, and the case remain stationary for years.

Treatment.—The prevention of bronchiectasis implies the prevention or cure of those conditions to which it is secondary. This is not often possible; but it is important that in dealing with all cases of bronchitis or broncho-pneumonia we should not lose sight of the possibility of consequent bronchiectasis, and that we should not discharge such patients till the lung has, as far as possible, regained the normal. We may have to insist that the patient shall not return to his old surroundings

or employment until his convalescence is complete. Such a course may often be much against the wishes of himself and his friends, as he may feel quite well and fail to appreciate our attitude.

In the treatment of actual bronchiectasis the general condition should be attended to, and chest complications avoided as far as possible. The cautions given under bronchitis are therefore applicable here. Having ascertained the position in which the cavity is most efficiently emptied, the patient should be advised to practise this postural coughing as soon as he wakens, or at least before breakfast is taken. For the treatment of the lung condition, creosote is the most useful drug. The most efficient method of administration is by a Yeo's inhaler, worn continuously, as far as possible. This is a small, conical, perforated zinc inhaler, with a sponge at the apex of the cone. It is kept in position over the nose and mouth by elastic bands passing over the ears, the sponge being wetted at intervals with the creosote. If the nose or face become sore, vaseline should be applied before adjusting the respirator, or it may be necessary to dispense with the respirator for a time and give the creosote internally. The exhibition of creosote in some patients leads to gastric disturbance, and this also may be a reason for its discontinuance. In favourable cases the good effect of the creosote may be measured by the diminution in the daily amount of sputum and by the lessening of the fœtor. The creosote vapour bath has been recommended by some authorities. It consists of a bare room in the centre of

which creosote is vaporised in a vessel placed over a flame; the door is fitted with an observation window. Beginning with an exposure of a few minutes only, the patients may later remain in this chamber for half an hour or more a day for several weeks. For those who cannot tolerate the administration of creosote, the following inhalant mixture should be used:

℞ Ol. pini. sylvestr. ♏ xlv.
Tr. benzoin. co., ad i oz.
Sig. 1 dr. to 1 pint of hot water for inhalation.

Intratracheal injections of various deodorising solutions with a basis of olive oil or glycerine have sometimes been employed with benefit. A special intratracheal syringe is required, with a long, curved nozzle. A suitable formula is:

℞ Menthol, 10 parts.
Guaiacol, 2 parts.
Olive oil, 88 parts.
One drachm of this fluid is injected once or twice a day.

In dealing with cases of bronchiectasis the possibilities of vaccine treatment should not be overlooked, though too much must not be expected from this measure. Where medical treatment fails to alleviate the condition, or where the patient is debilitated or unduly depressed by the disease, the question of surgical interference may be considered. Of surgical measures artificial pneumothorax should first be discussed; where the condition of the pleura admits of its being employed it has proved successful in some cases. More extensive operations

consist in removal of the ribs and direct drainage of the cavity ; this procedure has sometimes produced very satisfactory results, especially where the cavity is superficial, and where the overlying pleura is adherent ; but, generally speaking, the place of such surgery in the treatment of bronchiectasis is small.

FOREIGN BODIES IN THE AIR-PASSAGES

This condition is most common in children, but in recent years the widespread use of artificial dentures has provided a cause for an increased number of cases in adults. Foreign bodies capable of being accidentally inhaled include peas, beans, beads, boot buttons, etc. The inhalation of a tooth or portion of a dental drill during anæsthesia should be mentioned, since it may be overlooked. Paralysis of the larynx occurring in lunatics or as a result of diphtheria or bulbar paralysis acts as a predisposing cause in certain patients. Vomiting, with subsequent inhalation of the regurgitated stomach contents, provides a small group of cases in unconscious or semi-comatose patients, *e.g.*, drunken persons, epileptics, or children in convulsions ; such cases are usually immediately fatal, though the cause of death may not be apparent until the autopsy. It is slightly more common for a foreign body to lodge in the right lung than the left, owing to the obliquity of the left bronchus.

Symptoms and Signs.—Should the foreign body become lodged in the larynx or trachea, sudden distress, dyspnœa, and perhaps stridor develop,

and death may occur immediately. Once it has reached the bronchus, where the mucous membrane is relatively insensitive, the symptoms may be slight or absent for a considerable period, though there is usually some degree of cough. This abatement in the symptoms, lasting perhaps for weeks, has been known to lead both doctor and patient into a false sense of security. Subsequently the cough becomes more troublesome and more paroxysmal and is accompanied by an increasing amount of purulent expectoration, which typically is fœtid from its first appearance. Finally the condition shows itself as a unilateral bronchiectasis. For this reason the possibility of a foreign body should always be considered in any case in which such a bronchiectasis appears to have developed in the absence of previous lung inflammation. Apart from bronchiectasis other septic developments are not uncommon. Thus, abscess of the lung may develop and may lead to gangrene or empyema.

Foreign bodies entering the lung substance through wounds of the chest wall may give rise to pulmonary abscesses, empyema, or bronchiectasis, or may remain for many years without causing any symptoms, or perhaps only slight occasional hæmoptysis. One of us had a case in which a needle, impacted in a lung, caused such recurrent hæmoptyses during a period of several years. Shrapnel or bullet wounds of the lungs are occasionally followed by pulmonary tuberculosis.

In the initial stages the physical signs are obscure, though there may be diminution of the respiratory

murmur over the area of lung supplied by an obstructed bronchus. As the condition develops, râles may be found over the site of the foreign body, or rhonchi may be audible over that area, or over the affected lung. Ultimately, the physical signs of fibrosis, with bronchiectasis or abscess cavitation, may be found.

Diagnosis.—The diagnosis depends upon an accurate history, including an initial attack of choking dyspnœa, or, it may be, a recent operation under anæsthesia. Where the condition has persisted for some time, examination of the lungs may show evidence of collapse, fibrosis, or bronchiectasis. In such cases also the symptoms are correspondingly marked. A skiagram should always be taken as soon as possible, though, if the foreign body is of a vegetable nature, the result may be negative. In such cases the use of lipiodol may help to localise the site of the obstruction.

Treatment.—This is surgical. Exploration of the bronchi by means of the bronchoscope or through an opening into the trachea is the usual means of exposing and extracting the foreign body, where this is possible. The comparative comfort of the patient before the development of secondary changes in the lung should never lead the physician to postpone surgical interference, once the diagnosis has been definitely made.

CHAPTER IV

EMPHYSEMA—ASTHMA—HAY FEVER

EMPHYSEMA

EMPHYSEMA is a disease of the lungs in which there is hyperdistension of the air vesicles, with atrophy and rupture of their walls.

Several **varieties** of emphysema are described :

1. *Hypertrophic or Large-lunged Emphysema*, the commonest variety, is characterised by enlargement of the lungs, distension of the chest, dyspnœa, and cyanosis. The primary change affects the air-cells. These become over-distended, their walls lose their elasticity, undergo atrophy, and tend to rupture. As a result of this the lung capillaries are to some extent obliterated, and oxygenation of the blood is diminished, while the nutrition of the alveolar wall suffers. As the disease progresses bullæ of various sizes form, especially along the apical and anterior margins of the lung. These bullæ arise from the union of several affected areas, and the lung as a whole becomes bulky, inelastic, and pale, and has a characteristic downy feel.

2. *Atrophic or Small-lunged Emphysema.*—This is often part of a general senile atrophy, and is commonly found in weak and shrunken old people. In this form of the disease the chest is not enlarged

and the ribs are oblique. Cough and dyspnœa are the main symptoms, though the dyspnœa may not be marked. The physical signs are not distinctive, and the true condition may be revealed only at post-mortem, when bullæ are found to be present in the lung.

3. *Compensatory Emphysema.*—This variety is found round patches of disease due to tubercle, pneumonia, collapse, or fibrosis. It is best seen where one lung is affected with general fibrosis, while the opposite lung becomes much enlarged. Over the emphysematous lung the note is hyper-resonant and the breath-sounds are harsh. Commonly compensatory emphysema affects smaller areas of the lung, and is not recognisable on physical examination, being overshadowed by the signs of the primary disease.

4. *Acute Vesicular Emphysema.*—This is caused by violent inspiratory efforts occurring in such diseases as broncho-pneumonia, whooping-cough, and asthma. The condition develops rapidly and is easily overlooked, especially in children ; it is usually temporary, but if recurrent or prolonged, may pass into the chronic form.

5. *Interstitial or Surgical Emphysema.* — This means the escape of air into the connective tissue of the lungs, as a result of rupture of air vesicles during severe coughing or violent straining, or as the result of external trauma. Thus, after tracheotomy, air may enter by the operation wound and travel along the trachea to the bronchial tubes, finally finding its way under the visceral pleura.

As a rule interstitial emphysema gives rise to no symptoms and requires no treatment. It is one of the rarer causes of pneumo-thorax.

Ætiology.—It is now generally believed that repeated forcible expiratory efforts with a closed glottis, such as we find in the cough of chronic bronchitis or in occupations involving severe muscular effort, are the chief cause of the common large-lunged variety of emphysema. In other varieties it is believed that forcible inspiration may play an important part. This may be the case in asthma and in compensatory emphysema. In some patients a hereditary element can be recognised, which probably means that there is a congenital weakness of the elastic tissue of the lung. Pure emphysema is very rare, and the cases we meet with in practice commonly suffer from chronic bronchitis, the emphysema resulting from the chronic cough. Emphysema is a disease of middle or later life. It should not be forgotten, however, that, as Still has pointed out, it may be found in children recovering from attacks of asthma or bronchitis, or during the course of whooping-cough. Such cases are apt to be overlooked, unless it is observed that the exertional dyspnœa is out of all proportion to the physical signs in the chest.

Symptoms and Signs.—Emphysema usually comes under our notice as a part of chronic bronchitis. Some patients are stout and plethoric, while others are thin, bony, and round-shouldered.

The two main symptoms are dyspnœa and cyanosis, both of which may be very marked.

Cough and sputum vary with the degree of the accompanying bronchitis. The chest is rigid and fixed in the position of full inspiration. As compared with the normal chest the ribs as a whole are more horizontal, the upper ribs being crowded together and the lower wider apart. The subcostal angle is widened, the supra-sternal fossa is deeply marked, and the supra-clavicular fossæ may bulge when the patient coughs. There is some degree of spinal curvature, so that the scapulæ may lie almost horizontally. These changes give the chest a barrel-shaped appearance, which is well brought out by laying the patient flat on his back. The respiratory excursion is very small, the chest being raised, as a whole, by the sternomastoid and scaleni muscles. This diminution of expansion may be demonstrated by the cyrtometer, or by measurement, while the use of a spirometer may show a striking diminution in the vital capacity.

Some degree of clubbing of the fingers is occasionally met with, presumably when the bronchial branches have begun to dilate. A girdle of dilated venules may be seen along the line of origin of the diaphragm from the ribs, though its presence is by no means confined to emphysema. The apex beat of the heart is not usually palpable, but the pulsation of the right ventricle in the epigastrium is often visible. Vocal fremitus is usually diminished. The percussion note is hyper-resonant. The heart dulness may be lost, and owing to the displacement of the liver and the spleen the pulmonary resonance is correspondingly extended in a downward direction.

On auscultation the breath-sounds are characteristically enfeebled, with marked prolongation of expiration. The accompanying bronchitis is revealed by râles and whistling rhonchi. Occasionally sounds suggestive of fine friction are heard. The heart-sounds are feeble, but the second pulmonary sound is relatively accentuated.

Course.—Emphysema is a progressive disease, though with care and under good climatic conditions—bronchitis being thus kept at a minimum—life may be prolonged for many years. Death may occur from pneumonia or from gradual failure of the heart, with dropsy and other signs of that condition. A more rapid form of heart failure accompanied by sudden increase in the cyanosis and dyspnœa is occasionally a terminal event.

Treatment.—Since we cannot directly modify the structural changes in the lung tissue the main aim of our treatment is to prevent as far as possible attacks of bronchitis and asthma, and to deal with them appropriately should they arise. The hygienic and climatic treatment of this condition is thus as important as in chronic bronchitis, the underlying principles being much the same. The general condition of the patient should be attended to, and for this purpose tonics such as iron, arsenic, strychnine, or nux vomica may be given. The mouth and the gastro-intestinal tract should be kept healthy, the bowels being regulated if necessary by mercurial and saline purges, in order to prevent flatulence which aggravates the dyspnœa. If the occupation of the patient is laborious or otherwise unsuitable,

it should be changed, and if practicable he should live in a warm, equable climate. High altitudes are unsuitable, owing to the rarefaction of the air. Drug treatment is of minor importance. In most cases, there being concurrent bronchitis present, it is good practice to prescribe a stimulant expectorant mixture including 5 grain doses of potassium iodide and a few minims of tincture of nux vomica ; sometimes the addition of two or three minims of the liquor arsenicalis will prove beneficial. The compressed-air treatment, in which the patient is subjected to a pressure of two atmospheres, gives a certain measure of relief, owing to the increased amount of oxygen in the inspired air. Considerable temporary relief is also obtained by the direct administration of oxygen through a special apparatus. As the disease progresses symptoms of cardiac failure often appear, and the treatment of the heart condition becomes the primary consideration. For this purpose heart tonics such as digitalis and strychnine may be needed, while the onset of dropsy may call for the use of purgatives and diuretics in addition. Sudden heart failure with acute respiratory distress may demand venesection to the extent of twenty ounces. When emphysema is complicated by nocturnal attacks of asthma-like dyspnœa, regulation of the diet is especially important. The patient should not dine late, and there should be a reasonable interval between the last meal and going to bed. Attempts may be made at improving the respiratory excursion by breathing exercises or by compression of the chest

at the hands of a masseur. It should not be forgotten that emphysema is often an accompaniment of gout or granular kidney, and that in such cases the underlying condition demands treatment.

ASTHMA

Bronchial asthma is an affection of the lungs characterised by recurrent attacks of paroxysmal dyspnœa, affecting chiefly expiration, and accompanied by acute emphysema. Between the attacks the condition of the lungs may be perfectly normal. The term asthma has also been loosely applied to the dyspnœic conditions, sometimes paroxysmal in character, which are associated with cardiac and renal disease, as well as to cases of bronchitis or emphysema, in which dyspnœa is a marked feature. Patients are prone to describe as asthmatic any condition which is associated with paroxysms of coughing. Closely allied to asthma is the condition known as hay fever.

Ætiology.—*Predisposing Causes.*—In many cases there is a distinct neurotic factor which may be hereditary. The disease often begins in childhood, but may arise at any time, even as late as the menopause. Antecedent lung disease may predispose to asthma, and certain constitutional affections, such as gout, are recognised as favouring its development. Abnormal conditions of the nasopharynx, alimentary, genito-urinary, or cutaneous systems may act as predisposing causes, as may also enlargement of the bronchial glands.

Exciting Causes.—These are very numerous.

Odours from plants or animals, change of residence or climate, indiscretions of diet, and emotional excitement are among the most common.

Pathology of the paroxysm. It is generally agreed that the main factor is a spasm of the muscular coats of the smaller bronchi, probably accompanied by hyperæmia and swelling of the bronchial mucous membrane and by an exudation of mucin.

Symptoms and Physical Signs.—While the attack may be preceded by such premonitory symptoms as tightness in the chest, sneezing, the passage of a large amount of clear pale urine, flatulence, or mental depression, it is characteristically sudden in its onset. The patient may go to sleep feeling perfectly well, and awaken after some hours in acute respiratory distress. The character of the respiration is peculiar; the inspiratory phase is short, gasping, and jerky, but the patient's main difficulty is with expiration, which is drawn out, laboured, and ineffective. His appearance is one of acute distress. The face is livid or pale, and the expression anxious; he sits up in bed or leans forward in a chair; if seated, he grasps the sides of the chair to fix the extraordinary muscles of respiration; the neck veins are distended and there may be profuse sweating; speech is difficult or impossible. It is noteworthy that though the breathing is difficult the respiration rate is not necessarily increased. The temperature is not raised, the pulse is small, and the extremities are cold. It should be noted that during the paroxsym cough and expectoration are in abeyance.

The chest is fixed in the inspiratory position of acute emphysema and the respiratory excursion is slight. The percussion note is normal or slightly hyper-resonant. The areas of cardiac and hepatic dulness are diminished or absent, and the lung resonance is extended downwards. On auscultation the inspiratory phase is slight and hardly audible, but expiration is much prolonged. Whistling or sonorous rhonchi accompany both phases, but are most striking during expiration. Often they are appreciable on palpation and audible at the bedside. As the attack appears to be at its worst, the symptoms begin to abate. Usually after a fit of coughing the patient becomes much easier and brings up pellets of semitransparent gelatinous mucus. These mucous pellets, which are characteristic of asthma, consist of spiral casts of the bronchioles. Under the microscope they show a spiral thread of mucin to which adhere leucocytes, mostly eosinophiles ; or, it may be, a central clear thread round which is a spiral of mucous filaments. These constitute the so-called *Curschmann's spirals*. In the asthmatic sputum there may also be found transparent octohedral crystals, the so-called *Charcot-Leyden* crystals. Neither the spirals nor the crystals are pathognomonic of asthma. In bronchial asthma there is a marked increase in the eosinophiles of the blood, which may amount to 20 per cent. or more of the total leucocytes.

Course.—The duration of the attack varies. It may last from a few hours to several days, and pass off suddenly without apparent reason. In a severe

case the attacks may recur for several nights in succession, while during the day there is usually some degree of respiratory embarrassment. Uncomplicated bronchial asthma is not of itself a fatal disease, death in the paroxysm being practically unknown. Often the patient is quite well between the attacks, but in many cases chronic bronchitis is also present, with cough and persistent muco-purulent sputum. Emphysema may develop from repeated attacks of asthma, even apart from the existence of chronic bronchitis. It is very uncommon for an asthmatic subject to develop tuberculosis. In the end death may result from heart failure following upon emphysema and chronic bronchitis.

Diagnosis.—The diagnosis of asthma is based on the history of recurrent attacks of paroxysmal dyspnœa, predominantly expiratory in character. In conditions of laryngeal spasm and obstruction, such as may be found in laryngitis, laryngeal diphtheria, laryngeal neoplasm, laryngismus stridulus, or such as may arise in association with mediastinal growths or aneurysm, the dyspnœa is mainly inspiratory in character. Asthma-like attacks, occurring in the course of chronic renal or cardiac disease, and constituting the so-called "renal asthma" and "cardiac asthma," may simulate the bronchial affection more or less closely. It is important, therefore, to exclude the presence of these diseases in every case of paroxysmal dyspnœa. In uncomplicated asthma the characteristic sputum is of diagnostic importance.

Prognosis.—Asthma developing during childhood

may disappear as the child grows older. It is not directly a fatal disease, and death in the paroxysm is practically unknown, but confirmed asthmatics are rarely long livers. Death, when, in the end, it occurs, is commonly due to failure of the heart. Where the attacks are slight or rare the duration of life is not appreciably affected. In long-established cases the prognosis is less favourable, especially in the presence of emphysema and chronic bronchitis. In many cases a decisive factor is the ability of the patient to remove to a suitable climate.

Treatment.—1. *Of the Paroxysm.*—Immediate relief will in most cases be afforded by a hypodermic injection of 5 minims of 1 in 1000 solution of adrenalin chloride diluted to a syringeful with boiled water or normal saline. Temporary relief may also be obtained by the inhalation of amyl nitrite or of chloroform, or from a draught containing a drachm of 3 per cent. liquor ethyl nitrit. mixed with water immediately before use. A draught containing a 1 drachm dose of spirit. æther. co., or of spt. ammon. aromat. diluted with water to an ounce sometimes gives ease. Morphine gr. $\frac{1}{6}$ to $\frac{1}{4}$, with atropine gr. $\frac{1}{100}$ given hypodermically, seldom fails to give relief, but the danger of forming a habit is obviously very great, and it should be administered by the medical attendant only, and never as a routine measure. Some patients find relief by smoking special brands of asthma cigarettes, or by inhaling the fumes from burning powders containing such drugs as nitre, stramonium, lobelia, and hyoscyamus. It should be remembered that

such fumes tend to aggravate any existing bronchitis. Hot applications to the chest wall help to ease the spasm. The use of a Burney Yeo's inhaler, the sponge being impregnated with the inhalant solution given under gangrene (p. 118), is found useful by some. Nebulising fluids such as Dr. MacNaughton Jones's formula of atropine, cocaine, and balsams in oil are undoubtedly beneficial, though the administration of cocaine is not without danger. Oxygen given freely by means of a special mask or through a nasal catheter usually affords distinct relief. When the paroxysm is definitely associated with an overloaded stomach or with gastric irritation, an emetic may be given, such as apomorphine, gr. $\frac{1}{10}$ to gr. $\frac{1}{6}$, hypodermically, or zinc sulphate, 20 grs. in water, by mouth. An asthmatic child is often very frightened by a nocturnal attack. Every effort should be made to minimise the importance of the paroxysm by distracting his attention and avoiding fuss. In such young patients attention to the general health and habits is of the greatest importance ; over-eating, for instance, may prove to be the exciting cause.

2. *General Treatment.*—Apart from the treatment of the paroxysm, the drugs which benefit asthmatics most are belladonna, potassium iodide, arsenic, stramonium, grindelia, and lobelia ; while there are cases, especially at the climacteric, where the use of bromide is indicated, and where the administration of ichthyol is sometimes useful. Caffeine triiodide proves a serviceable drug in some cases. It is often given in the proprietary form of eupnine, dose 1 drachm. The drug treatment of asthma is often

necessarily a matter of trial and error, and many successful prescriptions are of the blunderbuss variety. The following have proved useful in different cases :

℞ Ammon. chlor.
Ammon. carb, aa. gr. iii.
Pot. iodid., gr. iv.
Pot. bicarb., gr. x.
Tr. stram., ♏ v.
Syr. tolut., dr. i.
Aq. chlorof., ad ½ oz.
Every four hours.

℞ Ammon. carb., gr. v.
Pot. iod., gr. x.
Vin. ipecac., ♏ x.
Ext. grindel. liq. U.S.P., ♏ xv.
Aq. chlorof., ad ½ oz.
Every four hours.

℞ Ammon. chlor., gr. v.
Pot. iod., gr. v.
Liq. arsenicalis, ♏ iii.
Tr. nucis vom., ♏ v.
Tr. scillæ, ♏ x.
Inf. senegæ, dr. i.
Aq., ad ½ oz.
Three or four times a day.

℞ Ammon. carb., gr. v.
Pot. iod., gr. v.
Vin. ipecac., ♏ x.
Aq. chlorof., ad ½ oz.

Three times a day (in conjunction with the formula printed next below).

℞ Tr. bellad., ♏ v.
Tr. hyoscyam., ♏ x.
Tr. digitalis, ♏ x.
Aq. chlorof., ad ½ oz.

Three times a day (in conjunction with the formula immediately above).

℞ Pulv. lobel. inflat.
Pulv. stram.
Pot. nitrat. aa., ptes. æqual.

Dissolve the nitre in plenty of hot water, pour it over the other ingredients previously mixed, dry the whole thoroughly, keep in a wide-mouthed bottle, box, or packet, and ignite a teaspoonful as required.

Pulv. lobeliæ co. B.P.C. may be used similarly.

Such prescriptions should be selected as far as possible in accordance with the peculiarities of each individual case, and their constituents may also be modified as occasion demands.

Careful search should be made for sources of peripheral irritation or of sepsis in the gastro-intestinal tract, the nasal passages, the teeth, and the genito-urinary system. Operation should be advised only when there is definite evidence of some local abnormality ; this caution is especially applicable to nasal operations. In dealing with children it is important that every effort should be made to maintain the general health and to regulate the alimentary system. In such patients it should be remembered that a condition of nervous instability often underlies the bronchial affection, and that attention to this factor may prevent the disease from becoming chronic and is therefore a cardinal part of the treatment. The dietetic habits of the patient should be carefully investigated. Heavy meals in the later part of the day should be forbidden, as these are often found to excite an attack. Constipation or flatulence, if present, should be treated, while there are cases in which no gastric or intestinal symptoms

are present, but which none the less respond to the use of such drugs as ichthyol, salol, dimol, and kerol. The patient's occupation should be considered, as it may expose him to dust or to exhalations of animal or other origin. The question of climatic treatment has often to be considered. In this matter no definite rule can be laid down, and a suitable place can be found only through a process of trial and error. Generally speaking, a dry climate at a moderate altitude is best, but it has been truly said of climate in asthma that one man's meat is another man's poison, for quite a short journey, even in the same town, may make all the difference to a patient's comfort. In many cases the asthmatic is more at ease in the town than in the country. In England, Bournemouth, Weybridge, Torquay, and the neighbouring districts, often prove suitable resorts; while in the North, Southport, Lytham, and Grange-over-Sands may generally be recommended. The question of a sea voyage should be considered where the paroxysms seem to be caused or aggravated by smoke, dust, fog, or organic exhalations. Amongst suitable winter resorts are Egypt, St. Moritz, and the Engadine, whilst Mont Dore in the Auvergnes has long had a special reputation in the treatment of this disorder at any time of the year.

Within recent years attention has been directed to the fact that some cases of asthma are associated with an undue sensitiveness of the body cells to certain proteins—**allergic asthma.** These proteins may be inhaled, as in the case of hay fever and cat asthma; they may be ingested in the food; or

they may be absorbed in the form of bacterial toxins from some infective focus. The foods which are associated with this hypersensitiveness are many—cereals, egg, milk, potatoes, and certain kinds of fish, especially shell-fish. Occasionally the proteins of meat, fowls, or vegetables are at fault. In a case of asthma, where the presence of such a causal factor is suspected, the patient's diet should first be experimentally altered, in order, if possible, to eliminate the offending protein. If this fails, certain vaccination tests which have been devised are now available. Different group proteins in creamy emulsion are applied to the skin, which is then scarified through the drop as in vaccination, a control scarification being done at the same time through normal saline. The test is usually performed on the inner side of the forearm. A positive reaction is shown by the development of a wheal at least a quarter of an inch in diameter, while little or no reaction appears at the control site. Having found the group protein at fault, the individual offending protein may be sought for in a similar way. Attempts at desensitisation are now made by hypodermic injection of the corresponding antigen, which is administered in increasing doses at weekly intervals. It is probable that too much importance has been attached to the specificity of such skin reactions in asthma, and some authors have given peptone orally and hypodermically on the theory that it acts as a general desensitiser, while it has also been found that a large percentage of asthmatics give a positive reaction to intra-

dermal injections of extracts of human dandruff. Where asthma is associated with chronic bronchitis vaccine treatment may sometimes be tried with benefit, an autogenous vaccine being prepared from the sputum. It should be noted that anaphylactic shock is especially prone to occur in asthmatics, owing to their hypersensitiveness to foreign proteins. Antitoxic sera should therefore be injected only when necessary and after careful consideration; the injection should then be given hypodermically and not intravenously, and should be begun with very small doses, *e.g.*, ·5 c.c., which may be repeated at intervals of 5 to 10 minutes in the absence of untoward symptoms until the complete dose has been given. Should such an anaphylactic crisis develop, it should be immediately combated by a hypodermic injection of 1 c.c. pituitrin, or 5 ♏ of 1 in 1000 adrenalin.

HAY FEVER

This is a seasonal affection, varying greatly in severity. It is characterised by injection and catarrh of the conjunctivæ and of the mucous membrane of the nose. In severe cases the condition may involve the accessory sinuses. Extension to the trachea and bronchi may give rise to paroxysms of true bronchial asthma. Asthma, eczema, and hay fever may occur in rotation in the same individual. Several members of one family may suffer from hay fever, or one may have hay fever while another has asthma, or even mucous colitis. In some families the disease seems to be

hereditary, or, it may be, that the "exudative diathesis" is hereditary, so that a mother may have hay fever, and one of her offspring severe eczema. Members of such a family are prone to show the phenomena of anaphylaxis.

At the time of the attack there is a general hypersensitiveness of the affected mucosæ, which is shown by an excessive and almost instantaneous response to stimuli, such as dust in the eye, which at other times of the year would cause much less irritation. There is also a specific hypersensitiveness to various organic particles or emanations, notably to pollens of various kinds, such as that of Timothy grass. These facts give the disease its name and its seasonal character.

Symptoms and Signs.—The attack develops suddenly, and may recur almost on the same date annually, unless wet weather postpones the onset. The symptoms vary much in severity. In well-marked cases they are those of acute coryza, but the sneezing or conjunctival discharge is mainly paroxysmal, requiring for its full development some external stimulus, such as a particle of dust, a specific pollen, or bright sunlight. Very often the earliest sign is lachrymation; copious watery discharge from the nose, with fits of sneezing, is also common, and the loss of fluid thus involved sometimes constitutes a definite drain on the patient's health, so that shivering, depression, or even prostration is complained of. Chest symptoms are not marked, though cough is not infrequently present, and in some patients definite asthmatic paroxysms

occur, especially in the later stages of the attack. A sense of dyspnœa may be experienced, usually at night, and at that time especially fine rhonchi may be found in the chest. Headache is not uncommon where the frontal sinuses are involved or where prostration is marked.

Treatment.—As far as possible steps should be taken to prevent the occurrence of the attack. Before the time of year when it is due, the patient should be immunised with successive doses of pollen toxin, though this is not successful in all cases. We have also obtained undoubted diminished severity of symptoms from the use of anti-catarrh vaccines a few weeks before the attack is due. Cauterisation of any injected patch of mucous membrane in the nasal cavities is indicated, and any grosser defects such as deflected septum or enlarged turbinates should be dealt with surgically. During the period usually covered by the attack the patient should avoid exposure to those pollens to which he is sensitive, to dust of all kinds, and to glaring sunshine. He should take things as easily as possible, and should avoid any articles of diet which he may find by experience to aggravate his sufferings, *e.g.*, strawberries or shell-fish. It may be desirable for him to sleep with the windows closed, and to wear coloured glasses with side-pieces to keep out dust particles, or Crookes' glasses to keep out ultra-violet rays. The antitoxin or pollanthin of Dunbar, applied locally to the conjunctiva and nasal mucosa every morning, is sometimes successful. Æstivin is similarly used. A

paroleine spray or ointments of vaseline or lanoline help to protect the sensitive mucosa from irritant particles ; in some cases the addition of adrenalin or cocaine is desirable. During an actual attack an alkaline nasal douche may be prescribed for use night and morning, and, where prostration is marked, a general tonic of arsenic or quinine may be given. Where a neurotic factor is present, as is frequently the case, the hydrobromide of quinine is the preparation to be preferred. Valerianate of quinine may benefit some cases. Removal to the sea coast or a sea voyage may greatly mitigate an attack, and is often a successful prophylactic measure. Stimulants as a rule are best avoided, owing to their tendency to increase the superficial circulation. Concentrated tobacco smoke is usually irritating to sufferers, but anti-asthmatic cigarettes may be smoked with impunity, or even with benefit. It has been argued that the attacks are due to deficient calcium retention, and that calcium compounds, *e.g.*, the lactate in doses of 30 grs., should therefore be taken internally during the season ; this theory may also explain the supposed acquired immunity derived from increasing age. In recent years we have heard of cases which have benefited from a combination of pituitary and suprarenal gland extract. They probably act by raising the blood pressure, which in these patients is usually below normal.

CHAPTER V

COLLAPSE OF THE LUNG—ŒDEMA OF THE LUNGS—PULMONARY INFARCTION

COLLAPSE OF THE LUNG

THE term "atelectasis" is best reserved for a lung which has never contained air, while the term "collapse" should be employed for cases in which the lung or part of it no longer contains air. It is not necessary to consider further the condition of atelectasis, but we have had a case of a middle-aged female in whom dextrocardia, accompanied by dulness and consonating râles over the lower portion of the right lung, was considered on X-ray examination to be the result of partial atelectasis, and the clinical history supported this view.

Ætiology.—Collapse of a whole lung is usually due to fluid or air in the pleural cavity. Lesser degrees of collapse may result from obstruction of the upper air-passages or bronchi, or may follow deficient expansion of the chest from such causes as spinal curvature. Lobular collapse is much more common than lobar. The precise mechanism of collapse is much disputed. It is generally agreed

that when the cause is obstruction of a bronchus or bronchiole, the condition is brought about by the absorption of air in the lung distal to the point of occlusion. Where there is no bronchial obstruction the process is not so easily understood, but loss of muscular power leading to deficient chest movement appears to be the main factor. This loss of power may be due to definite paralysis of the intercostal muscles or of the diaphragm, as in post-diphtheritic cases, or to abdominal or pleural inflammation preventing the full action of the respiratory muscles. In conditions of grave debility, a certain degree of collapse in the lower lobes is not uncommon.

Collapse is a physical condition of the lung, which is associated with various diseases. In children, especially, where the chest wall is yielding, as in rickets or debility, collapse of a lobular character is very prone to accompany bronchitis, bronchopneumonia, or bronchiectasis. This is particularly the case when the upper air-passages are obstructed by adenoids. In old people, and in patients exhausted by long or acute illnesses, such as enteric fever, pulmonary collapse is not uncommon, and is often associated with œdema of the bases. Pleural or pericardial effusion, aneurysm, or intrathoracic tumour may all lead to pulmonary collapse by mechanical pressure, and not infrequently the left lower lobe is similarly affected by marked enlargement of the heart. Collapse of the lung following abdominal operations is probably the result of several factors, namely, debility, abdominal dis-

tension, and inhibition of the movement of the diaphragm. Foreign bodies in the air-passages may lead to collapse of the lung beyond the point of blockage.

Symptoms and Signs.—The symptoms and signs of *lobular* collapse are almost invariably overshadowed by those of the associated condition. Its development during an acute inflammation of the lungs may be marked by an increase in the dyspnœa and the pulse rate, while the patient's general condition becomes worse. The physical signs are not distinctive—for the collapsed areas are small, and scattered thoroughout both lungs—though in children there may be inspiratory retraction of the intercostal spaces, and some degree of cyanosis. Where a larger area is involved the physical signs are usually more distinct. The percussion note may be definitely impaired, while the respiratory murmur is diminished in intensity, and may even be tubular in quality. Though râles cannot be produced in a completely collapsed area, fine râles are usually heard in the neighbourhood, if not over the area itself. Lobular collapse is easily overlooked and often cannot be diagnosed. Its gravity varies with the amount of lung involved and with the duration of the collapse. In many cases in children, and in some adults with influenza, it seems to occur as a transient condition, and to be of relatively little importance.

Massive or *lobar* collapse is relatively uncommon. It may arise from limited pneumothorax or from pleural effusion ; it may develop in the course of

capillary bronchitis, or be due to paralysis of the respiratory muscles. Sometimes it develops after an operation. Its onset may be acute, attended by dyspnœa, cyanosis, and prostration. In such cases the heart is often displaced towards the affected side, and over the collapsed area there may be appreciable dulness, with reduction of the respiratory murmur. Where the collapse is not absolute, fine râles are also present. The condition is more gradually developed in cases where mediastinal tumour or aneurysm has led to obstruction of a large bronchus.

Collapse of the lung as a whole is found in cases of pneumothorax or where an effusion occupies the whole pleural cavity. The degree of collapse varies with the degree of intrapleural pressure. In such cases the physical signs of collapse will, as a rule, be obscured by those of the primary condition, though tubular breathing may be audible posteriorly in the region of the root.

Diagnosis.—Collapse of the lung may be looked for in the presence of one of the conditions with which it is usually associated. Where it supervenes upon bronchitis in children, it may closely resemble broncho-pneumonia, but the course of the illness is not typical of broncho-pneumonia, unless indeed the latter disease supervenes, as not infrequently happens. Collapse of an upper lobe, from pressure of aneurysm or tumour, may lead to a diagnosis of pulmonary tuberculosis, if the primary condition is overlooked. Collapse of a lower lobe, such as is found on the left side as a result of cardiac

hypertrophy or large pericardial effusion, has been mistaken for pneumonia or tuberculosis, though in such cases the signs or symptoms of pulmonary inflammation are absent. Post-operative collapse is not infrequently diagnosed as lobar pneumonia, which it may closely resemble in the nature and location of the physical signs and in the degree of pyrexia; but the physical signs and the pyrexia commonly disappear within a few days, and, in any case, the initial rigor and the rusty sputum of pneumonia are absent. Total collapse of the lung, in the presence of massive pleural effusion or complete pneumothorax, is usually obscured by the primary condition, and the diagnosis is a presumptive one, unless confirmed by X-ray examination, prior to which, in the case of effusion, aspiration is essential.

Course and Prognosis.—Where the amount of lung tissue involved in the collapse is extensive, the prognosis is, as a rule, rendered more grave. This applies especially to weakly or rickety children. In the individual patient the danger may be estimated by the degree of cyanosis and dyspnœa, and by the extent of inspiratory recession of the thoracic wall and epigastrium.

Recovery from the acute illness may leave the child with a permanently damaged lung, in which fibrotic changes are prone to occur, leading sometimes to the development of bronchiectasis, and, it may be, to permanent deformity of the chest wall.

Treatment.—Attention should be directed to the primary condition, and the general strength of the patient should be maintained. As a rule, stimulant

expectorants are indicated, and diuretics are sometimes useful. Where collapse is associated with aneurysm, neoplasm, heart disease, or foreign body in a bronchus, the treatment, as well as the prognosis, is that of these conditions. In patients who are confined to bed, collapse of the lung may be prevented or lessened by frequent changes of the decubitus, so as to permit of more thorough expansion of the lungs; for this reason also the adoption of Fowler's position after an operation is often advisable. Respiratory exercises following aspiration are indicated where collapse is due to pressure by pleural effusion; and such exercises should also be employed in cases where its cause has been extreme debility or where it has occurred following operation. When a child with bronchitis shows symptoms of pulmonary collapse an emetic is a valuable form of treatment. Where the primary cause is paralysis of the diaphragm, and where the general condition of the patient is satisfactory, artificial respiration, as well as respiratory exercises, should be tried, and general stimulating measures should not be overlooked. In cases of acute collapse oxygen should be administered for the dyspnœa and cyanosis.

ŒDEMA OF THE LUNGS

Œdema of the lungs is characterised by serous exudation into the alveoli and alveolar walls. It does not occur as a primary condition. Two forms are recognised, the acute and the chronic.

Acute Œdema.—This variety is not common.

It is a generalised affection of the whole of both lungs. It occurs in degenerative conditions of the cardiac and renal systems ; sometimes, in association with " albuminous expectoration," it follows upon the aspiration of a large pleural effusion ; at times it develops in cerebral disease such as hæmorrhage, and it may also complicate some of the grave anæmias. Occasionally it is seen after the use of pilocarpine in kidney disease, as well as in angio-neurotic œdema, diabetes, hypoglycæmic coma, gassing by chlorine or other gases, and after the inhalation of certain anæsthetics.

Symptoms and Signs.—The onset is sudden, with much respiratory distress, the breath-rate being greatly increased. The marked dyspnœa is accompanied by cyanosis, while a frequent short cough is the rule. The expectoration is characteristically copious, serous, and frothy. It may be tinged uniformly with blood, so that it has a salmon-coloured or even bright red appearance. In the earlier stages there is no alteration in the percussion note, though later there may be appreciable impairment. On auscultation the respiratory murmur is found to be diminished generally, and fine bubbling râles are heard all over both lungs.

Course and Treatment.—As a rule the prognosis is serious in cases of acute pulmonary œdema. The effect of atropine subcutaneously, gr. $\frac{1}{100}$ to $\frac{1}{30}$, should always be tried. Venesection is a useful measure, while the administration of oxygen often does good. Recurrence is to be expected in angio-neurotic œdema cases.

Chronic Œdema is much more common than the acute variety. It is frequently found in the terminal stages of cardiac and arteriosclerotic conditions, and it occurs also in the course of acute fevers, accompanied by much prostration, *e.g.* influenza, typhoid, typhus. Unlike the acute form, it is not, as a rule, a generalised lung condition, but tends, on its first appearance at least, to affect the bases of the lungs. The physical signs are similar to those found in the acute variety, but are more localised. Where the condition is accompanied by fluid in the pleural sac, the râles may not be audible; in other cases there may be pleural effusion at one base, while at the other there are signs of pulmonary œdema, the usual explanation being that, on this latter side, the pleural cavity is obliterated by adhesions. The treatment is that of the primary condition, and the prognosis depends upon response to treatment. Local counter-irritation, as by cupping or by mustard leaves or plasters, may give some relief. Where there is much fluid in the pleura, its removal should always be considered.

PULMONARY INFARCTION

Pulmonary infarction or pulmonary apoplexy means effusion of blood into the tissues of the lung as the result of occlusion of a branch of the pulmonary artery. This occlusion may be due either to embolism or to thrombosis. In the former case, the embolus is derived from the right side of the heart in cases of chronic cardiac dilatation or in malignant

endocarditis, or it may arise from the detachment of part of the thrombus formed in the systemic veins. The veins of the leg or of the uterus after delivery are among the common sites of origin of the clot, which may also develop after operations on the pelvic or abdominal viscera. Venous thrombosis, from which such an embolus may take origin, is not infrequent in debilitating conditions such as tuberculosis, enteric fever, or malignant disease, or in acute toxæmic or septic conditions, such as pneumonia, influenza, pyæmia, or septicæmia. In some cases it is probable that the infarction is due not to the lodging of an embolus in the vessel, but to a primary thrombosis developing in the pulmonary artery in acute or chronic inflammations of the lung involving necrosis, chronic venous congestion, or increase of fibrous tissue.

Symptoms and Signs.—The symptoms depend upon the size of the vessel obstructed. If it is one of the larger branches of the pulmonary artery, death results after a few minutes of intense dyspnœa, cyanosis, and chest pain. In the case of smaller infarctions, these symptoms may also be marked, and may continue until death, or may slowly diminish as the patient gradually recovers. In other cases, especially those arising from chronic heart disease, the symptoms may be much less striking; but the presence of infarction is often indicated by increase of cough and dyspnœa, pain in the side of the chest, often localised but never intense, and the presence of blood in the sputum. The hæmoptysis characteristically consists of pure blood,

usually dark in colour. While pulmonary infarction is common in the later stages of mitral stenosis as a result of cardiac failure and dilatation, it should not be forgotten that hæmoptysis may occur in the early stages of this disease merely as a result of leakage due to high tension in the pulmonary circuit.

Where the infarction does not cause sudden death, physical signs more or less definite may be found over the affected area of the lung. The percussion note may be impaired, the respiratory murmur diminished, and pleural friction—indicative of dry pleurisy—may be found. Sometimes the breath-sounds have a bronchial or tubular character, while fine râles may be heard over or near the infarction. In the case of small infarctions, the physical signs are indefinite. The infarcted area undergoes changes which vary according to the nature of the obstructing clot. If the embolus is septic, it may develop into an abscess, or give rise to gangrene ; involvement of the pleura may lead to empyema.

Diagnosis.—Where the infarction is due to the blocking of a large vessel, the diagnosis is not usually difficult, being made from the striking nature of the symptoms and from their sudden onset. In less severe cases the condition has to be differentiated from pulmonary tuberculosis ; the absence of other signs of tuberculosis, and the presence in the heart or elsewhere of a probable source of origin of the embolus, will usually serve to settle the diagnosis.

Where the infarction follows an operation, it may simulate the onset of pneumonia, especially as both conditions are prone to occur in the lower lobe and

are relatively more common on the right side. But in pneumonia, as a rule, the initial symptom is intense pleural pain, whereas, in infarction, friction is often heard, but the complaint of pain is less marked, and special measures for its relief are rarely necessary. The rise of temperature is, as a rule, only slight, and the initial rigor, the typical rusty sputum, and the other symptoms of pneumonia fail to appear.

Treatment.—Where treatment is possible, initial shock and distress, when present, should be treated by a hypodermic injection of morphine, guarded, if necessary, by stimulants. The hæmoptysis itself does not call for treatment, as it is merely a secondary symptom and never directly fatal. Where cyanosis and dyspnœa are marked, venesection to the extent of half a pint or more may give relief. Some ease may also be obtained by the administration of oxygen. Where the embolus has been derived from a failing heart, treatment should be directed towards the heart condition, and for this purpose such drugs as strychnine, digitalis, pituitrin, and camphor may be given. Dry cupping or mustard applications may relieve local discomfort, while a purgative is generally indicated. In mitral stenosis, the occurrence of pulmonary infarction is often followed by some temporary relief of the patient's symptoms, though the increase in cough which sometimes results may be distressing enough to call for a sedative cough mixture.

CHAPTER VI

PLEURISY—EMPYEMA—PNEUMOTHORAX—HYDROTHORAX—HÆMOTHORAX

PLEURISY

INFLAMMATION of the pleura may be acute or chronic, and is further classified as dry or wet, according to the absence or presence of pleural effusion.

Acute Pleurisy

I. **Dry or Plastic Pleurisy.**—Here the inflammatory process stops short with the formation of lymph on the parietal and visceral pleuræ. In many cases dry pleurisy is only the precursor of pleurisy with effusion. It is often ascribed to cold, chill, or exposure, or it may develop after an operation. The main symptom is pain in the side, aggravated by breathing or coughing, and often attended by some fever. The physical signs consist of friction, coarse or fine, heard on auscultation and in some cases appreciable on palpation. The friction sounds are not necessarily best heard over the area of greatest pain, and, indeed, loud friction may be audible without any complaint of pain at all.

When that portion of the left pleural sac which

overlies the heart is involved in the inflammation, the friction sound may take on cardiac rhythm, as a result of the movements of the heart. This is known as *pleuro-pericardial friction*, and is at times confused with pericardial friction. Unlike the latter, however, it may vary in intensity as a result of movements of the lung. As a rule, it is best heard if the breath is held at the end of expiration, while a deep inspiration may lead to its momentary disappearance.

After several days of pleurisy, friction may be no longer heard ; resolution may have occurred, fluid may have been interposed between the pleural membranes, or their surfaces may have become adherent. Dry pleurisy is found as a complication of many lung diseases. It is usual at the beginning of lobar pneumonia, it is a frequent initial symptom of tuberculosis, and it may arise from involvement of the pleura in suppurative, gangrenous, or neoplastic affections of the lung.

Inflammation of the diaphragmatic pleura may occur by itself or as part of a general pleurisy. Where the diaphragm alone is involved, the condition rarely proceeds to effusion. As a rule, especially at the onset, pain is a striking feature ; it is usually most marked over the region of the diaphragm and over the upper abdomen, while there may be referred pain over the shoulder on the affected side. There is sometimes tenderness in the region of the tenth rib. While pain is more prominent than in other varieties of pleurisy, physical signs are slight or absent. Dyspnœa may be

obvious. The breathing is costal in character, the abdominal muscles being held rigid. This rigidity, which may be associated with vomiting and other gastro-intestinal symptoms, may lead to a diagnosis of a surgical condition in the abdomen. The intensity of the pain, its acute onset, and the fact that it may vary in intensity with change of posture, further increase our diagnostic difficulties. The detection of friction or of effusion may indicate the true nature of the case. Sometimes the diagnosis is reached only by a process of exclusion. X-ray screening may show some limitation of the respiratory excursion of the diaphragm on the affected side.

II. Pleurisy with Effusion, or Sero-Fibrinous Pleurisy.—In this variety the inflammatory process goes on to the formation of fluid exudate, varying in amount from an ounce or two to several pints. It may begin acutely as dry pleurisy, with pain in the side and malaise, and with friction sounds audible on auscultation ; or its onset may be insidious and the gradual appearance of dyspnœa may be the first indication of the presence of a large effusion.

Ætiology.—As in acute dry pleurisy, exposure to chill may directly precede the attack. Such exposure may act by lowering the resistance to bacterial invasion, and indeed it is now generally believed that the majority of cases of so-called idiopathic pleurisy with effusion are tuberculous in origin. This belief is supported by the fact that other tuberculous lesions may precede, accompany, or follow, pleurisy with effusion. Among the less

common causes of pleurisy with effusion are acute rheumatism, intrathoracic tumours, aneurysm, chronic nephritis, and pneumonia, though in some of these conditions the fluid is rather a passive transudate than an inflammatory exudate. In pneumonia serous effusion is only occasionally found, and fluid, when present, is, as a rule, definitely purulent. Pleurisy with effusion may follow local injury to the chest wall, or it may arise from an extension of inflammation from the pericardium or from a sub-diaphragmatic lesion. It is a common complication of artificial pneumothorax. It may also occur as part of a polyserositis. After abdominal operations diaphragmatic pleurisy with some effusion is occasionally observed. Other conditions mentioned as causes of dry pleurisy may also be operative here. In the majority of cases no micro-organism can be found in the fluid by film, culture, or even by inoculation, but cytodiagnosis may prove valuable in arriving at the probable ætiology.

Symptoms and Signs.—In the majority of cases the onset is acute, with malaise, slight pyrexia, shivering, cough, and pain in the chest. The pain is usually felt in the lower part of the chest, between the nipple and the scapula. It is stabbing in character, and is aggravated by coughing, deep breathing, and sometimes by movement or pressure. It may be referred to the shoulder or abdomen. In children especially, the complaint of abdominal pain may tend to obscure the chest condition, and suggest the presence of acute abdominal disease. Cough is not

usually a marked symptom and may be absent, while sputum, if any, is small in amount. In cases where the onset is insidious, the above symptoms are little if at all noticed, and the only complaint may be that of increasing dyspnœa. Cyanosis, if present at all, is slight, even when the effusion is large. The degree of pyrexia varies ; in some cases it may reach as high as 103° F., but usually it is less, and may not exceed one degree.

In the early stages the physical signs are usually those of dry pleurisy, *i.e.*, pleuritic friction is heard on auscultation. As the effusion increases, the findings become more characteristic. The affected side may be seen to be relatively immobile and distended, and the apex beat may be obviously displaced towards the healthy side. Palpation reveals marked diminution or absence of vocal fremitus over the region of the fluid, and the heart, liver, or spleen may be felt to be displaced. A moderate left-sided effusion leads to the abolition of the tympanitic note normally elicited over Traube's space. The percussion note over the effusion is markedly flat, and the extent and degree of the dulness correspond to the size of the effusion. Percussion will sometimes demonstrate the fact that the effusion, where moderate in amount, is highest in the axilla, its level falling towards the sternum and towards the spine, when the patient is standing or sitting. The percussion note is characteristically flat, and is accompanied by a greater sense of resistance than that yielded by consolidated lung. Where the effusion is large enough to displace the

mediastinal contents towards the sound side, a triangular area of dulness can sometimes be demonstrated by percussion at the base of the sound lung. This is known as Grocco's triangle, and its base may extend outwards from the spine for about two inches, the apex being upwards. Percussion of the lung above the level of a moderate effusion sometimes yields a note of peculiar tympanitic character, which constitutes the so-called Skodaic resonance. It is usually best heard under the clavicle. On auscultation the breath-sounds are found to be diminished, and with a large effusion they may be entirely absent. Occasionally bronchial breathing is heard over the effusion ; this is rare in adults, but is not infrequent in children. In the lung above the effusion the breath-sounds tend to be exaggerated and râles may be audible there, or may even be heard through the fluid if the exudate is small. The phenomenon known as *œgophony* is sometimes heard about the upper level of the dulness ; by it we mean that the voice-sounds have acquired a high-pitched, tremulous, bleating character. Baccelli believed that the whispered voice is transmitted through serous, but not through purulent exudate ; this distinction cannot be regarded as generally valid, though we have found it useful in some cases. The use of an aspirating needle is much more satisfactory.

Diagnosis.—There is often a history of more or less sudden onset, with pain in the side, and at this stage pleuritic friction may be heard over the affected lung. Pleurodynia or the pre-eruptive

pains of herpes zoster may simulate the commencement of the disease, but in neither of these conditions does pleural friction occur, and with pleurodynia there is often local muscular tenderness. When the effusion is established, the diagnosis is made from the relative immobility and distension of the affected side, the peculiarly flat percussion note accompanied by the characteristic sense of resistance, the absence of tactile fremitus, and the diminution or absence of the breath-sounds. It should be remembered that bronchial breathing over a dull area does not exclude the presence of fluid, especially in young children, in whom evidence of displacement of the heart or other organs should always be looked for. Indeed, displacement of the apex beat, whether in adults or children, may be the first indication noted on inspection. Moreover, friction sounds may be heard through the fluid, probably owing to surface conduction, and this fact should not lead the practitioner to discard the diagnosis of effusion when the other signs indicate its presence. *Litten's sign* is sometimes found in thin patients suffering from pleurisy with effusion or pleural adhesions. It means the diminution or absence of the diaphragmatic movement, which is visible in such persons, when healthy, as a shadow traversing the lower intercostal spaces in the axillary region. To detect it, this region should be inspected in an oblique light, the patient lying supine, with his feet to the light, and the observer standing well away from the bed. Where the presence of fluid is doubtful, the pleural cavity

should be explored with a stout, sharp needle attached to a syringe. The puncture is most conveniently made in the line of the inferior angle of the scapula and a space or two below it, *e.g.*, the eighth interspace. The needle should be inserted just above the upper border of the rib. If local anæsthesia is considered necessary, a preliminary injection of novocain should be made over the site chosen for puncture. It is most convenient to have the patient sitting up in bed, leaning forwards, and he should be instructed to keep perfectly still while the puncture is being made. If no fluid is obtained, the needle should be examined to see if it has become blocked by clot, fibrin, or periosteum. The fluid, when found, should be preserved for examination in a sterile test-tube. Having ascertained that fluid is present, one must now consider the cause. Since tuberculosis is responsible for a large percentage of the cases, we must seek for other evidence of that disease in the family and personal history of the patient. Evidence of infiltration may be found at one or other apex by clinical or X-ray examination; the sputum, if any, should be examined for tubercle bacilli, and when the pleural condition has cleared up, the patient should be kept under observation for many months. When a large effusion appears stealthily in a young person the condition is probably one of tuberculosis. If the patient is over forty, the appearance of a pleural effusion is often the first sign of intrathoracic growth, especially if the fluid is blood-stained, or if it reaccumulates rapidly after aspiration. We should therefore look carefully

for other evidence of malignant disease in the chest or elsewhere. In this connection a skiagram of the chest taken soon after aspiration is desirable. The use of the X-rays in cases of pleurisy generally is often helpful; it may establish the tuberculous nature of the pleurisy by revealing evidence of intrapulmonary disease which may have escaped detection on physical examination, or it may show the presence of other conditions, *e.g.*, hydatid cyst or paralysis of the diaphragm, which occasionally simulate pleural effusion. In the rare instances in which a serous effusion accompanies a pneumonic process in the lung, evidences of pneumonia will be found in the history, the signs of consolidation, and the sputum. Chronic nephritis causing pleural effusion can be recognised by examining the urine, the cardiovascular system, including the blood pressure and the optic discs. In some such cases the fluid is opalescent in appearance. Occasionally it consists of pure chyle; this is a rare condition following disease or injury of the thoracic duct. Where a pleural effusion is of long standing, cholesterin crystals may be formed, and on shaking the tube they appear as small, shimmering flakes.

Course.—The great majority of cases of uncomplicated pleurisy with effusion proceed to recovery, though the duration of the illness is much longer than in the acute dry form of the disease. The rate of absorption varies in different cases; smaller effusions are spontaneously absorbed, but where the amount of fluid is large, aspiration is necessary, and may have to be repeated where the fluid tends

to recur. In many cases some rise of temperature persists as long as fluid is present. When fluid is no longer present there is a tendency to shrinkage over the affected side, which may lead to scoliosis and displacement of the heart. A considerable number of the cases subsequently develop pulmonary tuberculosis—a fact which emphasises the need for careful convalescence and periodic examination thereafter.

Treatment.—In dealing with pleurisy with effusion in a working man it is most important to see that the employer has, from the outset, some idea of the probable duration of the illness. It should be made clear that his return to work is a question of months, not of weeks. Omission to do this may lead to much misunderstanding and irritation.

The patient should be put to bed in a well-ventilated room, and the diet should be light. Calomel should be given at the outset and followed by a saline aperient next morning. In dry pleurisy, or in the early stage of sero-fibrinous pleurisy, the most prominent symptom is pain. Strapping the side will often afford much relief. Broad strips of adhesive plaster overlapping each other and extending beyond the middle line before and behind are used; these should be applied from below upwards, each being adjusted at the end of an expiration. Alternative measures are hot fomentations, poulticing, dry cupping, or blistering. If these fail, a hypodermic of morphine may be given. If cough is troublesome, a sedative mixture may be

prescribed, such as elixir heroin c. terpin co. B.P.C., in 1-drachm doses, or the following formula :

℞ Tr. camph. co., ℥ xx.
Vin. ipecac., ℥ x.
Syr. scillæ, ½ dr.
Syr. tolut., ½ dr.
Aq. chlor., ad ½ oz.
Every four hours.

In many cases of pleurisy such a mixture as the following may be useful :

℞ Sodii salicyl., gr. xv.
Pot. iodid., gr. iii.
Liq. ammon. acetat., 2 dr.
Inf. gentian. co., ad ½ oz.
Every four hours (and later t.d.s.).

The appearance of effusion may call for additional measures, though in many cases no special treatment is needed. Absorption of the effusion may be hastened by the use of purgatives, diuretics, and diaphoretics. A useful diuretic mixture is the following :

℞ Pot. iod., gr. v.
Pot. citrat., gr. xx.
Inf. digitalis recent., dr. ii.
Aq. chlorof., ad ½ oz.
Every four hours.

When, however, the effusion is excessive or persistent, counter-irritation may be employed by applying to the chest such local stimulants as iodine, lin. camph. ammon., mustard leaf or plaster, antiphlogistine or chilli paste ; or the area may be dry cupped.

While small effusions need no special treatment, since they are absorbed naturally in due course, the question of *aspiration* has to be considered where the amount of fluid is great. The indications for aspiration are :

i. When the fluid is sufficient in amount to cause respiratory or cardiac embarrassment.

ii. When the upper limit of the dulness reaches the neighbourhood of the third rib.

iii. When the fluid remains stationary for two or more weeks, without any evidence of absorption.

iv. When the fluid is accompanied by pulmonary œdema or by effusion on the opposite side.

The site of aspiration is the same as that for exploratory puncture, and one may employ a trocar and cannula or an aspirator. During the operation the patient should be carefully watched, and if cough, faintness, hæmoptysis, or albuminous expectoration appears, the aspiration must be stopped. In the vast majority of cases the operation is simple and harmless, though fatal syncope has occasionally occurred. In many cases one aspiration is sufficient, and the removal of even a small quantity of fluid may lead to the spontaneous absorption of the rest. Even the mere act of exploration, whether fluid is obtained or not, seems in some cases to start the process of absorption. Re-accumulation of the fluid may demand repeated aspiration. Where tubercle is the underlying condition, it is not advisable to remove more than about a pint, unless, perhaps, air replacement is done at the same time, since too

sudden a removal of a large amount of fluid may lead to a rapid development of intrapulmonary tuberculosis. In non-tuberculous conditions larger amounts, even several pints, may be safely removed, but it is not wise to attempt to empty the pleural cavity by powerful suction with the aspirator. When no further aspiration is necessary, attempts should be made to re-expand the lung. This may be done by practising deep breathing, or by the use of a pair of Wolff's bottles, provided with tubes so arranged that the patient can transfer the water from one bottle to the other by blowing down one of the tubes. Abdominal respiration should also be practised in order to re-establish free diaphragmatic movement, and thus aid the expansion of the affected lung. By strapping the healthy side of the chest, and thus lessening its movement, the expansion of the partly collapsed lung may be increased. During convalescence the general health must be attended to, and cod-liver oil, together with such tonics as syr. ferri. iodidi or Easton's syrup in 1-drachm doses, may be given. When, as frequently happens, the condition is apparently due to tuberculosis, the question of sanatorium treatment should always be considered, and, in any case, the patient should be treated on sanatorium lines. In other cases of simple pleurisy with effusion, climatic treatment will also be beneficial. No patient should be allowed to return to work until recovery is complete, though this may take many months.

III. Chronic Pleurisy.—This condition is characterised by thickening of the pleura. It may follow

dry pleurisy, pleural effusion, serous or purulent, acute lung inflammations like pneumonia, or chronic lung disease like tuberculosis. By itself, thickening of the pleura may cause no symptoms, but if it is extensive, or if it is a part of a fibrotic condition of the lung, the patient may complain of dyspnœa and of occasional dragging pains in the side. Where the pleura is considerably thickened, collapse of the lung may occur, and, in any case, there is usually shrinkage of that side of the chest, with visibly deficient expansion. If the condition is of long standing, scoliosis may be present. The percussion note is impaired over the affected area, and the dulness may be marked enough to suggest fluid. The breath-sounds, as a rule, are diminished. This is often partly due to the fact that the lung beneath such a thickened area of pleura is rarely normal, and may at different times show varying degrees of congestion, with moist sounds audible on auscultation.

IV. Chronic Pleural Effusion.—This is persistent unabsorbed pleurisy with serous effusion. It is a rare condition, and should prompt the physician to look for evidence of tubercle, mediastinal tumour, or nephritis.

Treatment of Chronic Pleurisy.—A primary condition, *e.g.* tuberculosis, should be sought for and treated. Attention should be paid to the patient's general health on the lines indicated above. Attempts to restore the normal function of the lung by pulmonary exercises may be made, and spinal deformities should be as far as possible prevented or treated.

EMPYEMA OR PURULENT PLEURAL EFFUSION

Ætiology.—Empyema may arise in several ways. In some cases, especially in children, the onset is insidious, and the condition is often overlooked. There is loss of flesh and appetite, hectic fever, and perhaps vomiting and diarrhœa. The pulmonary symptoms may be slight, but if much fluid is present there is obvious dyspnœa, with a " catch " in expiration. In adults, empyema is most commonly found as a sequel of lobar pneumonia ; in children it may follow either lobar or lobular pneumonia. In such cases the causal organism is the pneumococcus. Streptococcal empyema may result from a septic focus in the lung, may complicate a specific fever such as scarlatina, or may arise as part of a general infection, such as septicæmia or pyæmia. It is sometimes due to trauma of the chest wall. Tuberculous empyema may develop directly from a tuberculous serous effusion, or may accompany pulmonary tuberculosis.

Symptoms and Signs.—Effusion complicating or following lobar pneumonia is almost always purulent. In such cases the crisis is ill defined, and is followed by a rise in the temperature and in the pulse rate. Dyspnœa may be obvious on inspection. Sometimes there is a definite interval of several days between the crisis and the appearance of symptoms of empyema. The patient's general condition remains poor or becomes worse. Chills, with more

or less profuse sweating, are common. The signs of effusion are found over the affected lung, and on exploration the fluid is seen to be purulent. A small area of local œdema is present over the empyema in a few cases, and forms a reliable indication of intrapleural pus. This œdematous patch should be chosen as the site for exploratory puncture. In children, wasting and fever may be the main symptoms of latent empyema ; in such cases the physical signs will usually be found if looked for. Tuberculous empyema is generally discovered on exploring a persistent pleural effusion in a tuberculous subject ; it is not a common condition.

The signs are those of pleurisy with effusion. In a few cases there may be local œdema of the chest wall over a portion of the affected pleura. The physical signs persist ; they do not lessen, as they so often do in serous effusion. In the differentiation of purulent from serous effusion little importance is now attached to Baccelli's sign (*vide* p. 90). Occasionally one meets with an empyema which is pointing and pulsating, the pulsation being transmitted from the heart ; but a pulsating serous effusion is never found. Tenderness of the chest wall over the effusion is not common, but favours the diagnosis of empyema as against that of serous effusion. Displacement of organs should always be looked for, as it is a valuable indication of fluid in the pleura. Where empyema has been left untreated for some time, *e.g.* in the latent empyema of children, clubbing of the fingers may appear with relative rapidity—sometimes, it is said, within several

weeks. It should be noted that X-ray examination cannot decisively differentiate between pus and serum in the pleural sac. In practice such differentiation is usually effected by exploratory puncture.

Diagnosis.—This is based upon the presence of the signs of pleural effusion, accompanied by symptoms of septic absorption, and following upon a pneumococcal or septic lesion in the lungs or elsewhere. In conditions where the development of empyema is a possibility, the temperature, pulse, and respiration should be carefully and frequently recorded, as a definite increase in any one of these may be the first indication of pleural sepsis. The appearance of leucocytosis or its increase is a useful confirmatory sign, especially in adults. The diagnosis should always be confirmed by exploratory puncture, and it should be remembered that a negative result by no means excludes empyema. A common error is to use too fine and too short a needle for exploration ; a stout needle, at least three inches long, will be found the most suitable. Puncture may have to be repeated in different places and in different directions, and varying depths may have to be sounded before pus is struck. Even this procedure may be unsuccessful, and a skiagram of the chest may be necessary to show the presence of fluid, if this happens to be unusually situated, *i.e.*, if the empyema is interlobar, loculated, or encysted. Such cases naturally present difficulties in diagnosis. An interlobar empyema may simulate lung abscess, or may suggest malignant disease of the lung. A diaphragmatic empyema following a

diaphragmatic pleurisy is uncommon, and gives rise only to vague signs. Apical empyema, which is also rare, may simulate new growth or pulmonary tuberculosis. In such cases a careful consideration of the history, an X-ray examination, and exploratory puncture are essential diagnostic measures, but they are not infallible, and the true condition may be apparent only when the pus is spontaneously discharged externally as an *empyema necessitatis*, or ruptures into a bronchus, or when, in the less fortunate cases, it is found post mortem.

There are cases in which the suddenness of the onset, as well as the accompanying symptoms, suggests acute pneumonia, but a careful examination reveals the physical signs of fluid, and exploratory puncture will disclose the true condition of affairs. Again, it should be remembered that in children the signs of fluid may not be at all characteristic, and may suggest consolidation rather than effusion. Not infrequently a diagnosis of tuberculosis of the lung is made where the true condition is one of non-tuberculous empyema. In children, for instance, the history of chest symptoms accompanied by marked wasting, hectic fever, and sweats, strongly suggests tubercle, but in such cases the patient is septic rather than tuberculous in appearance; the signs are those of fluid which is basal in situation, and there is often obvious displacement of the heart and audible dyspnœa. The presence of similar symptoms following upon an attack of lobar pneumonia in an adult may lead to a suspicion of tuberculosis, but it should always

be remembered that lobar pneumonia in a previously healthy subject never leads directly to tuberculosis. Here, again, exploratory puncture should not be omitted. Where an empyema discharges into a bronchus and the voided fluid is fœtid in character, bronchiectasis may be suspected, especially since clubbed fingers are found in both conditions. A consideration of the history of the case should obviate this error. Bronchiectasis usually develops gradually, whereas, in an escaping empyema, the fœtid sputum definitely appears in large quantity at a certain moment of time. Moreover, there is not the regular alternate filling and emptying of the cavity, such as we find in bronchiectasis, and the expectoration is merely purulent, without the other characteristics of bronchiectatic sputum. Abscess of the lung may also be closely simulated by an empyema, especially if the pus is discharged into a bronchus, but with abscess the signs of pleural involvement are generally less marked than in empyema; the physical signs usually resemble those of broncho-pneumonia, there may be much constitutional disturbance, and a primary septic focus may be found elsewhere in the body. It should be remembered that a form of chronic abscess of the lung may result from rupture of an empyema through a bronchus.

The pus obtained from exploratory puncture should always be preserved for examination. The pneumococcus is the organism most commonly found, especially in children, the streptococcus being relatively somewhat more common in adults.

More rarely other organisms are present, such as the staphylococcus or Friedländer's pneumobacillus. In tuberculous cases the presence of the tubercle bacillus may be demonstrable by microscopic examination or animal inoculation, though both of these may be negative. In non-tuberculous empyema the predominant cell is the polymorph, and such an excess of polymorphs in a fluid which is doubtfully purulent points to its being septic in character.

Course and Prognosis.—Left to itself, empyema may be cured naturally in one of several ways: rupture may occur into a bronchus and the pus be voided by expectoration; the fluid may be partly absorbed and partly inspissated, leaving only a much thickened pleura; rupture may occur externally over any part of the chest wall, usually in front, or, in rare cases, in the upper abdominal or lumbar region. The pus has been known to burrow down the front of the spine, in such a way as to simulate a psoas abscess. In other cases, where no treatment is adopted, death may result within several months from septic absorption or from exhaustion. Complications, such as pericarditis or cerebral abscess, may prove rapidly fatal; in the more chronic cases, lardaceous disease is sometimes found.

Following operation a cure is effected in the majority of cases. Where the condition is tuberculous, the outlook is grave, whether operation is done or not. Streptococcal cases have a less favourable prognosis than those due to the pneumococcus.

Treatment.—Once the presence of pus has been demonstrated, the treatment is surgical, resection of a rib and evacuation of the pus being the recognised procedure. But when the physician has found pus and turns the case over to the surgeon, he should be careful to indicate to him accurately the spot at which the successful puncture was made, and also the direction and depth of the exploring needle, since it is well known that cases occur in which an exploring needle has struck pus, but where none has been found at operation. After operation the general condition of the patient usually improves rapidly, and this improvement should be encouraged by every means at the disposal of the physician. In addition to tonics, a change of air is often advisable, and sometimes results in the disappearance of the discharge in a surprisingly short time. Efficient drainage throughout is, of course, essential for satisfactory convalescence. Respiratory exercises are helpful in hastening the cure. Where, after several months have elapsed, the discharge still continues undiminished, the question of further surgical interference must be considered.

When the fluid removed on exploration is doubtfully purulent, the treatment to be adopted depends on the general condition of the patient. If this is not desperate, aspiration should be performed and the question of operation held over. A cytological and bacteriological examination of such a fluid should always be made. If, after aspiration, the fluid reaccumulates, and at the same time the patient

is losing ground, there should be no further hesitation in operating. Extreme weakness is no bar to operation for empyema; where a general anæsthetic is considered risky, a local anæsthetic should be employed. In urgent or grave cases, where the medical attendant is not prepared to undertake a rib resection, *e.g.*, in a country district, much temporary relief and improvement may be obtained by a preliminary draining of the pleural cavity, through a simple intercostal incision, or even by repeated aspiration.

In some cases of empyema in children, treatment by repeated aspiration has been employed, but our experience has been that such cases usually require resection and drainage sooner or later. The treatment of tuberculous empyema is unsatisfactory, and repeated aspiration is to be preferred here to more radical treatment.

PNEUMOTHORAX

Pneumothorax means the presence of air in the pleural sac. This air may enter the sac from without, through a penetrating wound of the thoracic wall, and in such cases the lung may be punctured, and air may enter the pleural cavity by the bronchial tubes as well. In civilian life such wounds are comparatively rare, and in the great majority of cases of pneumothorax the air enters the pleural cavity from within as a result of disease of the lung. In four-fifths of the cases, the primary disease is pulmonary tuberculosis. Other causes are gangrene, abscess, rupture of an emphysematous bulla, and

empyema escaping through a bronchus. Among rarer causes may be mentioned subdiaphragmatic growths or abscesses perforating the diaphragm. There have been cases in apparently healthy subjects in which the condition has developed in the absence of any primary lung disease.

Pneumothorax may occur in one of three forms. Where the pleural sac communicates freely with the external air either through a bronchus or a wound in the chest wall, the intrapleural pressure is atmospheric. In closed pneumothorax the perforation becomes sealed up, and the occluded air tends gradually to be absorbed. In valvular pneumothorax, a rare variety, the opening is partially closed by a flap of tissue which acts as a valve, so that the air enters the pleural cavity during inspiration, but finds no exit during expiration ; in this form the intrapleural tension continues to increase, and may exert on the lung a pressure comparable to that of a large pleural effusion. Simple pneumothorax is uncommon, since the pleural cavity usually becomes infected, and the result is a hydropneumothorax or more frequently a pyopneumothorax.

Symptoms and Signs.—The onset of pneumothorax is usually determined by violent coughing or exertion. Where the condition develops in the course of a chronic disease, such as pulmonary tuberculosis, it may remain unsuspected until discovered by routine examination of the chest. This is specially true where the pneumothorax is partial or localised, and in such cases physical examination may be negative and the diagnosis may be made only by X-ray

examination. As a rule, however, the moment of perforation is marked by acute pain in the side, some degree of collapse, and great dyspnœa. The patient may feel as if "something has given way" in the chest. The pulse is small and rapid, and cyanosis is obvious. The dyspnœa may be very alarming, but, as a rule, the distress disappears after a few days or weeks, when the thoracic viscera have accommodated themselves to the new conditions.

Where the air pervades the whole of the pleural sac, the affected side is distended, the intercostal spaces being flush with the ribs. In addition to the distension, there is relative immobility, and the apex beat of the heart may be seen to be displaced towards the sound lung. The respiratory excursion of the diaphragm on the affected side may be appreciably lessened. Palpation confirms the above findings, and reveals a diminution or absence of vocal fremitus over the affected lung. Percussion gives a note which is hyper-resonant, tympanitic, or even distinctly dull, according as the intrapleural pressure is atmospheric or greater than atmospheric. In a left-sided pneumothorax the cardiac dulness is diminished or abolished and the splenic dulness lowered, while in a right-sided one, liver dulness is absent, the liver being displaced in a downward direction. On auscultation the respiratory murmur is very feeble or absent, and in the open variety of pneumothorax it may have an amphoric quality. In the region of the hilum over the collapsed lung the breathing is distant and tubular. Râles, when present, may have a metallic character, and curious

tinkling, echoing sounds may accompany respiration, cough, or speech. Pectoriloquy may be present where the pneumothorax communicates with a bronchus. A characteristic auscultatory phenomenon is the coin sound or bell sound, *bruit d'airain*. To elicit this, a coin should be held flat on the chest wall by the thumb and ring finger, and tapped by the edge of another coin held between the index and middle fingers. The stethoscope is placed over some other part of the affected side, and the tapping is heard as a bell-like sound.

We have seen that pneumothorax is almost always secondary to some other disease of the lungs or pleura, and that it rarely remains simple, but is usually followed by serous or purulent effusion. The physical signs of pneumothorax, therefore, are commonly complicated or obscured by those due to consolidation of the lung or to fluid in the pleural sac. In the former case, *e.g.* pulmonary tuberculosis, the pneumothorax may be only partial owing to the presence of localising adhesions, and the diagnosis may then be impossible apart from X-ray examination. Where fluid complicates a pneumothorax, certain valuable signs are often present. The dulness due to the fluid will be found to alter with the position of the patient, and when the patient is in the upright position and is examined from the back, the upper level of the fluid may be demonstrably horizontal, unlike that of many simple pleural effusions. On screening the chest, this flat surface of the fluid is strikingly seen, and shaking the patient causes visible ripples to pass

over it. The shadow due to the fluid strongly contrasts with the upper part of the thorax, which, in the absence of gross adhesions, is abnormally clear, the lung having retracted and collapsed towards the root. Again, on shaking the patient from side to side and keeping the ear meanwhile applied to the chest wall, a splashing sound may be heard—the so-called Hippocratic succussion splash. To elicit this sign, the patient should sit up in bed, and a huckaback towel should then be placed over the back of the chest next the skin. The physician applies his ear over the affected lung, places one hand below each axilla, grips the trunk, pushes it away from him towards the other side of the bed, and then pulls it sharply back. On this recoil jerk the splash is heard, if the air is accompanied by fluid, clear or purulent.

Diagnosis.—The diagnosis is based upon the history, the relative fulness and immobility of the affected side, the diminution of vocal fremitus, the altered percussion note, the reduction of the respiratory murmur, and the displacement of the heart, spleen, or liver. The coin phenomenon and the presence of tinkling adventitious sounds strongly confirm the diagnosis. Where possible, a skiagram of the chest should always be taken. Conditions which simulate pneumothorax are not common. In emphysema, though the percussion note is hyperresonant and the breath-sounds weak, both lungs are affected, and there is no history of acute onset. Large tuberculous cavities, especially where there is much pleural thickening, may give diminished,

distant, and tubular breathing, which may also be accompanied by tinkling adventitious sounds. But in such a case the heart would be displaced towards the affected side, and the lung as a whole be shrunken and not distended. A subdiaphragmatic abscess containing air has been known to cause difficulty in diagnosis, but here the preceding symptoms are predominantly abdominal and not pulmonary, and the characteristic signs of pneumothorax are absent. In the rare condition of diaphragmatic hernia the signs are generally left-sided, and vomiting occurs. The diagnosis must be verified by X-rays and bismuth meal. The most common error in dealing with pneumothorax is to overlook its presence, either because attention is concentrated on the primary disease, or because some of the characteristic features of pneumothorax, *e.g.* the bell-sound, are not present.

Course and Prognosis.—Where pneumothorax occurs in otherwise healthy persons, and in many cases where it is of traumatic origin, recovery usually occurs spontaneously. Where it is secondary to empyema, surgical evacuation of the pus may lead to complete cure. In cases of tuberculosis the outlook varies; where the condition is localised and small, the course of the disease is not affected, but where most of the lung is collapsed, and purulent effusion is present as a complication, the outlook is bad. Sometimes the development of a pneumothorax tends to arrest the lung disease—a fact which is the basis of the modern treatment of phthisis by artificial pneumothorax.

Treatment.—When the onset is sudden and attended by collapse and dyspnœa, it is best to give a hypodermic injection of morphine. Diffusible stimulants are also useful. In the valvular variety, if the intrapleural pressure rises so as to cause much distress, the air should be withdrawn by means of a fine trocar and cannula. This may have to be repeated, and should be supplemented by strapping the lower ribs on the affected side. If effusion appears, no special treatment is necessary so long as it remains serous and causes no distress. When pus is present it should be evacuated by rib resection, as in empyema. In pyo-pneumothorax complicating pulmonary tuberculosis, aspiration, repeated as necessary, is often the best line of treatment, and more severe surgical measures should be adopted only after deliberation.

HYDROTHORAX

Hydrothorax is a passive, non-inflammatory transudation of serous fluid into the pleural cavity. It is most commonly found in cases of dropsy of cardiac or renal origin, and in such conditions it may precede the development of dropsy elsewhere. The fluid of hydrothorax differs from that of pleural effusion in having a lower specific gravity, and a lower albumin content, while the predominating cell is endothelial, though lymphocytes may also be found. In cases of heart failure the right pleural cavity is more often affected than the left, when the condition is not bilateral ; but unilateral hydrothorax may mean that the pleural cavity on one

side is obliterated by old adhesions. The hydrothorax of renal disease is usually bilateral. The physical signs are those of pleurisy with effusion, though in the latter disease it is unusual for both pleuræ to be affected. The signs and symptoms of the condition are usually obscured by those of the primary disease. The treatment is that of the primary condition, but, if there is much distress, paracentesis is indicated, and may have to be repeated. It should be remembered that aortic aneurysm and intrathoracic tumour are causes of hydrothorax which are often overlooked.

HÆMOTHORAX

This means the presence of blood in the pleural cavity. It may be due to trauma, or to rupture of an aortic aneurysm ; it may be a manifestation of the hæmorrhagic diseases such as purpura or scurvy, and it is also found in the hæmorrhagic forms of fevers, such as typhoid and small-pox. The physical signs are those of fluid in the pleural cavity. If a large amount of blood is suddenly poured into the pleural sac, as may happen with a ruptured aneurysm, the symptoms are those of collapse and urgent dyspnœa, and the case is usually rapidly fatal. In traumatic cases the blood should be left alone, as it will gradually be absorbed, provided it does not become infected. The onset of this complication is usually marked by a sudden great increase in the pulse rate, and immediate surgical interference is then indicated.

CHAPTER VII

ABSCESS OF THE LUNG—GANGRENE OF THE LUNG

ABSCESS OF THE LUNG

ABSCESS of the lung is a very rare disease. It occasionally follows pneumonia, and in traumatic cases may occur as a result of perforation from without. Other possible causes are deglutition or aspiration pneumonia, the extension of tuberculous disease from the spine or ribs, neoplasm of the œsophagus or of the lungs, foreign bodies in the bronchi, rupture into the lung of an empyema, or of abscesses originating in the abdomen, *e.g.*, amœbic abscess of the liver. Multiple abscesses of the lung, usually pyæmic in origin, are commoner than a single abscess.

Symptoms and Signs.—The symptoms are those of general septic infection, accompanied by those of local inflammation of the lung, including cough, dyspnœa, and pain. The sputum is purulent, and sooner or later becomes fœtid. Microscopically it contains elastic fibres, and micro-organisms of various kinds. The physical signs are variable. They are often those of lobular pneumonia ; sometimes signs of cavitation can be demonstrated.

Multiple pyæmic abscesses cannot be recognised clinically. The signs of empyema may be found if the abscess reaches the surface of the lung.

Diagnosis.—This is often difficult. There should be evidence of a primary condition, of which abscess of the lung is a possible complication. In bronchiectasis the general symptoms are less acute, there is no evidence of sepsis elsewhere, the condition is gradually developed and is chronic in character, and the sputum does not contain elastic fibres. The differentiation of abscess of the lung from gangrene is not always possible, especially as either of these conditions may pass into the other. As a rule, however, the fœtor is less marked in abscess than in gangrene, and, at first at any rate, the sputum of abscess may be free from fœtor. As a rule also it is more definitely purulent and lighter in colour than that of gangrene, nor does it settle in three layers as gangrenous sputum tends to do.

Course.—The outlook is usually grave. In addition to the primary disease, which may be severe, complications such as empyema, bronchiectasis, and gangrene may develop. Sometimes a chronic abscess is established, which may lead to the development of amyloid disease, though in some cases the general health may be but slightly affected for a long period.

Treatment.—Medical treatment is merely symptomatic. Postural coughing may aid evacuation of the purulent sputum. Where the abscess is single and superficial, it should be dealt with

surgically by rib resection and drainage. In most cases death occurs before such treatment can be instituted. In cases of lung abscess where the origin is obscure the possibility of a foreign body in the lung should not be overlooked. Surgical treatment of the primary condition may be necessary. In chronic cases an autogenous vaccine may be employed. We have had successful cases with stock vaccines.

GANGRENE OF THE LUNG

Gangrene of the lung is a rare disease and is never primary. Occasionally it occurs as a terminal complication of lobar pneumonia ; it is more common in broncho-pneumonia, especially when that disease follows the aspiration of food into the lungs, or the administration of an anæsthetic. It may arise from pressure upon the lung tissue by new growth or aneurysm. Its development is favoured by conditions of general debility such as diabetes, typhoid fever, alcoholism, and insanity. In children it may supervene upon the broncho-pneumonia of measles or whooping-cough, especially in the weakly or ill-nourished. The gangrene may affect a whole lobe or a whole lung, or it may have a broncho-pneumonic distribution involving parts of both lungs.

Symptoms and Course. — The onset may be sudden, but more commonly it is insidious, and is obscured by the symptoms and signs of the primary disease. A sudden onset may be attended by rigors ; the patient's condition becomes more grave,

and the breath and sputum become extremely fœtid—more fœtid than in any other lung disease. Hæmoptysis may occur and prove directly fatal. The sputum is copious, and may be greenish-brown or black in colour. On standing it separates into three layers—frothy, serous, and puriform. Under the microscope it may show elastic fibres or even fragments of lung tissue. It contains micro-organisms of various kinds, including pyogenic cocci, and the *Bacillus coli communis*, as well as anaerobic bacilli, which are believed to be responsible for some of the features of the disease. The presence of acid-fast bacilli has also been demonstrated in some cases of gangrene of the lung apart from the existence of any tuberculous focus. The temperature may be normal, but as a rule there is some pyrexia. The pulse is rapid, and its quality is poor. Cough is violent, and possibly paroxysmal. The physical signs are not distinctive. There may be evidence of bronchial catarrh or of consolidation, though these signs may be obscured by an empyema. If the gangrenous patch involves the surface of the lung, pneumothorax or empyema may occur. The diagnosis is made from the intense fœtor, the peculiar sputum, and the presence of a primary cause for the gangrene. It should be noted that an insane person may die of pulmonary gangrene following deglutition pneumonia, without exhibiting either fœtor or cough; the diagnosis may have to be based upon the steady decline in the general condition, a slight evening temperature, and a rapid and progressively weakening pulse, while

physical signs are slight or indecisive. The fact that the sputum contains fragments of lung tissue but no tubercle bacilli supports the diagnosis of gangrene. The differentiation of gangrene from abscess of the lung has been considered under pulmonary abscess. As compared with bronchiectasis gangrene is an acute condition, and prostration is much more marked.

The **prognosis** in gangrene of the lung is always grave, though some cases do recover.

Medical **treatment** consists in supporting the patient's strength. Where feasible, surgical interference is indicated as offering the best hope of recovery. Inhalations of creosote on a Yeo's inhaler, and the internal administration of creosote should be tried; perhaps their best service is in lessening the fœtor.

The following formulæ will be found useful:

℞ Ammon. carb., gr. v.
Pot. iod., gr. v.
Creosot., ♏ ii.
Tr. scillæ, ♏ x.
Inf. senegæ, ad 1 oz.
Fiat. mist.
1 oz. four hourly.

℞ Acid. carbol.
Creosot.
Sp. chlorof.
Sp. æther.
Tr. iodi, aa. ptes. æq.
Fiat vapor.
Apply six to ten drops to the sponge of a Yeo's inhaler, and inhale as directed.

CHAPTER VIII

INTRATHORACIC TUMOURS

TUMOURS OF THE LUNG

PRIMARY tumours of the lung, whether innocent or malignant, are rare. Secondary growths, both carcinomatous and sarcomatous, are much more frequently met with following primary neoplasms elsewhere, *e.g.* the breast, bone, alimentary canal, testicle, bladder. Such secondary deposits are usually found as separate masses scattered through both lungs. Primary cancer of the lung may be found at any age, but is commonly met with in middle life, and males appear to be affected more frequently than females. Such a primary tumour usually remains unilateral.

Symptoms and Signs.—In the early stages no characteristic symptoms are present, and when symptoms do arise, the case may be regarded as bronchitis or pleurisy; but the patient does not improve, the cough becomes more troublesome, there is loss of flesh, and perhaps some irregular pyrexia. Expectoration may be absent, or mucopurulent, and small in amount. In a few cases it has a red-currant-jelly or even a prune-juice character, which is strongly suggestive of the true diagnosis. More commonly, however, there is

hæmoptysis with no special characteristics, unless it be that it is recurrent and small in amount. Pain may be absent, but in a considerable proportion of cases it is present either as a pleuritic stab, or as a more or less constant boring ache. Some degree of dyspnœa is usually present. At first it may be noticed only on exertion, but it tends to become progressively worse, and may finally reach a fatal asphyxia. As the mediastinal glands become involved, pressure symptoms often develop, and the picture then becomes that of mediastinal tumour.

The physical signs of cancer of the lung vary with the stage of the disease. When the case first comes under notice, we may find that over one lung the respiratory murmur is definitely reduced and is accompanied by persistent rhonchi. Such a combination occurring in a middle-aged person should be regarded with suspicion, especially when it is accompanied by repeated small hæmoptyses or a frequent harassing cough. When the condition is well advanced, and the growth has reached the periphery of the lung, the signs may be fairly characteristic. Inspection occasionally reveals a bulge of the chest wall over the seat of the tumour, so that the presence of an aneurysm may be suspected. Expansion may be somewhat diminished over the affected side of the chest. Where the growth underlies the chest wall, palpation will show diminution of vocal fremitus, and percussion will give a note which has a characteristically dead dulness. There may be some displacement of the cardiac impulse. On auscultation the respiratory murmur

is often markedly diminished, and there is a striking absence of adventitious sounds, though a persistent localised rhonchus may occasionally be noted. In the physical examination of the chest this combination of dulness and silence, especially in the upper half of the lung, is highly characteristic of malignant disease. It should not be forgotten, however, that chronic tuberculosis, with much thickening of the pleura, may yield similar signs, but in such a case there is some degree of shrinkage over the affected side. Signs of pleural effusion may precede or accompany those of pulmonary cancer. The pleural fluid may be hæmorrhagic in character, a fact which must not be regarded as pathognomonic of malignant disease, since such an exudate is found in other conditions, *e.g.*, tuberculosis. In primary endothelioma of the pleura, a rare condition, a bloodstained effusion is common, and characteristically tends to recur very quickly after removal. Secondary deposits may be found in the axillary or cervical glands, and should always be looked for in a doubtful case. Where possible, the chest should be examined under the X-ray screen, and a skiagram taken. If an effusion is present, it should be removed shortly before such an examination is undertaken.

Diagnosis.—The disease may be mistaken for bronchitis or for pleurisy. When there is no response to treatment, the possibility of tuberculosis may be suspected, but repeated search for tubercle bacilli in the sputum will give negative results, and the fever, if present, is usually slight. Orthopnœa

and stridor, rare in tuberculosis, are not uncommon in intrathoracic cancer. X-ray examination is always desirable, and is often decisive by enabling us to exclude such conditions as aneurysm and hydatid cyst. The taking of the Wassermann reaction should be a routine measure, as intrathoracic syphilis, as well as aneurysm, may simulate neoplasm. The duration of the illness is of diagnostic importance, as a history of symptoms lasting for more than six months is strongly against a diagnosis of pulmonary new growth.

Prognosis and Treatment.—The course of the disease is steadily downward, though striking remissions may occur. Death takes place from exhaustion, broncho-pneumonia, gangrene, or asphyxia. Apart from syphilis of the lung simulating neoplasm, the treatment is symptomatic, but deep X-ray therapy and the application of radium sometimes afford considerable relief.

MEDIASTINAL TUMOURS

Primary mediastinal tumours are more common than primary tumours of the lung. The majority of such tumours originate in the lymph glands of the anterior, middle, or posterior mediastinum. Some are believed to develop in the remains of the thymus gland. They are almost always malignant in character, lympho-sarcoma being the commonest variety. Males are more often affected than females, and it is, we think, a fact that there is a greater proportion of cases in young subjects

than one would expect. The disease is usually described as uncommon, but its incidence appears to vary in different parts of the country, and we have found it far from uncommon in the Manchester area, where—like cancer of the lung—it appears to have increased in frequency in recent years. Secondary mediastinal tumours are not common, and do not always cause characteristic symptoms.

Mediastinal tumour usually arises from the lymph glands in one of the mediastina. As the growth proceeds, glands in the other mediastina are affected, and the site of origin may not be apparent at autopsy. The tumour gradually infiltrates the lung tissue, and this infiltration is generally more marked on one side of the chest, usually the left, than on the other. The infiltrating cells travel along the bronchi and the vessels from the root of the lung. Secondary growths may be found in the liver, pancreas, and spleen, as well as in the axillary and cervical glands.

Symptoms and Signs.—The characteristic symptoms of mediastinal tumour are due to the pressure which it exerts upon the other structures within the thorax. Pressure upon the large veins, such as the superior vena cava, results in the distension of the superficial veins of the neck, the arm, and the chest wall. Over these areas, too, there is often obvious congestion, and later there is definite œdema, so that swelling of the neck and face is noticed, and male patients may have to wear larger collars than formerly. Where the trachea is compressed, there may be more or less constant stridor in the breathing. Dysphagia may arise from pressure

of the growth upon the œsophagus. Pain is present in many of the cases. It may occur as a boring ache in the back of the chest or as a darting pain in the neck and arm ; if the intercostal nerves are involved, severe pain on one side of the chest may be complained of. The onset of the disease is usually insidious. Dyspnœa is a constant symptom. At first it is slight, but it tends to become severe and perhaps paroxysmal in character, and finally the patient may die from suffocation. It is due to pressure on the air tubes, the heart, or the recurrent laryngeal nerve. It is increased by the progressive infiltration of the lung by the malignant growth, and is often further aggravated by the presence of a pleural effusion. Cough is a very constant symptom. It may be very troublesome, and sometimes shows a paroxysmal character. It may have a brassy quality. Hoarseness or aphonia is not uncommon, and may even constitute the first sign of the disease. There is rarely any disparity of the pulses or of the pupils. As the infiltration of the lung proceeds, expectoration, hitherto slight or non-existent, becomes more abundant ; it is sometimes streaked with blood, or may be like red-currant jelly in appearance. Large hæmoptyses sometimes occur. As a rule, emaciation is not a characteristic feature, but it occurs in the later stages of the disease, or may develop suddenly from occlusion of the thoracic duct.

When the disease is well established, the appearance is usually characteristic. Dyspnœa is obvious, and frequently reaches orthopnœa. The patient

is distressed and anxious, and may look cyanosed and half-choked, or his face may be ashen grey. There may be distension of the superficial veins over the upper part of the chest, more marked on one side, œdema of one arm, and swelling of the neck and head. Where the superficial involvement of the lung is marked, palpation will show diminution of vocal fremitus, and the physical signs may be those described under cancer of the lung, including evidence of pleural effusion. Enlargement of the cervical or axillary glands is sometimes present. The apex beat of the heart may be displaced.

Diagnosis.—Where the evidences of pressure upon the veins are well marked the diagnosis of mediastinal tumour is not usually difficult, since they are uncommon in any other form of intrathoracic disease. The chief difficulty is in the differentiation of aneurysm from mediastinal tumour, though this problem has been simplified by the introduction of the X-rays and of the Wassermann test. Neither of these tests is conclusive, since it is obvious that mediastinal tumour, apart from gumma, may occur in syphilitic subjects ; and the interpretation of the screen shadows is not always easy. Irregularity of the outline of the X-ray shadow is in favour of tumour. It should not be forgotten also that syphilitic disease of the mediastinum may simulate mediastinal cancer, so that a Wassermann test should always be done, and the effect of the exhibition of potassium iodide always ascertained. In the clinical differentiation of tumour and aneurysm we should consider :

i. The duration of the symptoms. Mediastinal tumour usually kills in less than a year, while aneurysm may exist for several years.

ii. The age of the patient. In patients under 35, and also in the elderly, tumour is commoner than aneurysm. Both are rare in women.

iii. The presence of obstruction to the venous return, as shown by distension of the veins, congestion and œdema, or swelling of the face and neck. This points to tumour rather than to aneurysm.

iv. The presence or absence of the characteristic signs of aneurysm, such as arteriosclerosis, slapping second sound, murmurs, tracheal tugging, and expansile pulsation.

v. Inequality of the pupils is in favour of aneurysm.

vi. Inequality of the pulses is also in favour of aneurysm, as growths in this region seldom compress or invade arteries.

vii. Pain, severe and widespread, or constant and boring, is rather in favour of aneurysm, though such a pain may be found in tumour. Anginoid attacks may occur in either condition.

viii. A palpable tumour, showing definite expansile pulsation, is strongly in favour of aneurysm.

ix. Marked and extensive superficial dulness over the lung, with diminution of all auscultatory findings, is characteristic of mediastinal tumour extending into the pulmonary tissue.

x. Recurrent pyrexia is in favour of growth. It may be caused by a secondary broncho-pneumonia or by the damming up of bronchial secretion by pressure upon the tubes.

xi. A negative Wassermann reaction is strongly in favour of tumour.

xii. Loss of weight favours tumour.

xiii. The results of X-ray examination.

Among other conditions which may be mentioned as causing difficulty in diagnosis are :

(i) Extensive pericardial effusion. Here there is usually a history of some condition with which such an effusion is associated. The triangular shape of the dulness, the weakening of the heart-sounds and of the apex impulse should prevent mistakes.

(ii) Pleural effusion. It should be remembered that pleural effusion often accompanies intra-thoracic growth, and may indeed be the first sign of that condition. An exploratory puncture should be done at the base, and the fluid examined microscopically. This may reveal the presence of endothelial cells and a comparative absence of lymphocytes or polymorphs ; where the effusion is bloodstained, the cytological picture will be correspondingly altered. The chest should be screened as soon as convenient after removal of the fluid, which may rapidly recur.

(iii) Differentiation of mediastinal tumour from primary cancer of the lung is often difficult, and may be impossible by physical examination. Early evidence of pressure upon veins is in favour of mediastinal growth. An X-ray film may settle the diagnosis.

(iv) Mediastinal abscess. This condition will give rise to a prolonged hectic temperature, leucocytosis,

and other febrile symptoms which are not common in mediastinal tumour as continued symptoms, though they may recur from time to time.

(v) Indurative mediastino-pericarditis. This is a rare condition, lasting longer than tumour. The signs are those of cardiac embarrassment, accompanied, it may be, by ascites or pleural effusion, or both, and there may be *pulsus paradoxus*.

(vi) Hodgkin's disease, beginning in, or affecting the mediastinal glands, may give all the signs and symptoms of mediastinal tumour. In any case where it is possible, a superficial gland should be removed for microscopical examination. Enlargement of the spleen, and more or less regularly recurring periods of pyrexia, are in favour of Hodgkin's disease.

Prognosis and Treatment.—The prognosis is grave. Where the tumour is syphilitic in character, the administration of potassium iodide may result in cure. The effect of iodide of potassium, the syrup of the iodide of iron, and of liquor arsenicalis, should be tried in all cases, and benefit has been reported from the intensive use of arsenic by intravenous injection. Venesection sometimes gives temporary relief, and the same is true of the administration of oxygen. Where the pain is severe, opium is indicated, though milder remedies, such as aspirin and dial, should be tried first. Usually the disease advances steadily, and death occurs from exhaustion or suffocation or from secondary pneumonia. The onset of such a pneumonia may pass unnoticed unless a careful temperature pulse

and respiration chart is kept. In some cases a temporary remission of symptoms is a striking feature of the disease, and treatment by radium emanation plates or by deep X-ray therapy may retard the fatal issue for weeks or months. The total duration of the disease subsequent to diagnosis rarely exceeds six months. Death may occur with unexpected suddenness.

CHAPTER IX

SYPHILIS OF THE LUNG—ACTINOMYCOSIS OF THE LUNG—HYDATID DISEASE OF THE LUNG

SYPHILIS OF THE LUNG

SYPHILIS of the lung is clinically an uncommon condition, and can rarely be diagnosed with certainty. In congenital syphilis it appears most often as the so-called white pneumonia of the fœtus, where the alveolar walls are infiltrated and the alveoli blocked with desquamated epithelial cells. The condition is incompatible with life, though the child may survive for a few hours.

Acquired syphilis of the adult may produce a chronic fibrosis in the lungs. Usually only a portion of one lung is involved, and the physical signs closely resemble those of pulmonary tuberculosis in their character and evolution, though they are commonly found over the lower lobe rather than at the apex. Tracheal or bronchial stenosis may be present, and bronchiectasis may develop. In such a case repeated examinations of the sputum for tubercle bacilli are negative, and a history of syphilis or a positive Wassermann reaction is obtained. The general health is not

affected to the same extent as in pulmonary tuberculosis. It should be remembered that pulmonary tuberculosis may develop in a syphilitic patient, and that many cases regarded as syphilis of the lung ultimately prove to be tuberculous, though both diseases may be represented in the lung lesion. Improvement under anti-syphilitic remedies sometimes shows the true condition. X-ray examination may yield a picture indistinguishable from that of pulmonary tuberculosis, or from secondary carcinoma of the lung. A marked increase of the root shadows resulting in broadening of the mediastinum seems to be a feature in skiagrams of pulmonary syphilis, while the lung lesions are basal in distribution, have a bronchial radiation, and are less flocculent than those of tubercle. Lung syphilis may be accompanied by severe and repeated hæmoptysis. Pulmonary tuberculosis may be suggested by the purulent or even nummular character of the sputum. The pyrexia of active tuberculosis, however, is not found, though a rise of temperature may occur if septic complications are present ; such complications include bronchiectasis, pneumonic conditions arising from the pressure of a gumma on a bronchus, and septic conditions elsewhere, *e.g.*, in one of our cases, frontal sinusitis.

Gummata, varying in size and number, may be found in the lungs of syphilitic subjects, and the breaking down of a large gumma may simulate tuberculosis. Gummata, when present, are usually situated in the lower lobes and towards the lung root.

It will be seen that the diagnosis of pulmonary syphilis is never easy. There may be no symptoms, or the symptoms and signs may suggest bronchitis, bronchiectasis, pulmonary tuberculosis, or a post-pneumonic fibrosis. Where fibrosis is a feature, dyspnœa may be marked. In practice the diagnosis is made by a process of exclusion; we cannot demonstrate the presence of tubercle bacilli by microscopic or inoculation tests, we have no reason to believe that the condition is post-pneumonic, while the Wassermann test is positive, or there is a definite history of syphilitic infection.

Treatment.—In all cases this should be anti-syphilitic, usually of the non-intensive variety. Iodide in large doses will do much to promote the absorption of gummata, though a time may be reached when no further progress can be made till a course of mercury is undertaken. Intravenous or other injections of arsenical compounds may be given if there is no myocardial or other contra-indication.

ACTINOMYCOSIS OF THE LUNG

This rare disease, due to the ray fungus (*Streptothrix actinomyces*) may affect the lung either primarily or secondarily. In the established disease the symptoms closely resemble those of pulmonary tuberculosis, but the physical signs are found at the base more commonly than at the apex. They may suggest bronchitis, tuberculosis, pneumonia, or chronic pleurisy. There is a marked tendency for the lesion to spread directly from one tissue to

another, and the process may thus extend from the lung outwards through the chest wall, forming a tumour, then an abscess, and finally a sinus. Such a course of events is very rare in pulmonary tuberculosis. In many cases of actinomycosis of the lungs there may also be found lateral curvature of the dorsal spine with the concavity towards the affected side.

Diagnosis.—This can be made with certainty only by the demonstration of the fungus in the sputum or other discharge. It may be visible to the naked eye as small globules of a dirty yellow colour. Microscopically it is seen to consist of filaments which show true branching, and which tend to form a meshwork. These filaments are Gram-positive. Sometimes the mycelium formed in the human disease is surrounded by a band of club-like radiations, though these clubs are uncommon in man as compared with cattle.

The question of actinomycosis should be raised when we meet with a case of apparent tuberculosis in which the sputum is persistently negative, the chest signs basal, and in which the other features are not typical of tubercle. Evidence of the disease should be sought for in other situations in the body, *e.g.*, mouth, intestine, skin, or liver.

The patient may or may not give a history of association with cattle or grain. The precise mode of infection indeed is debated. Some believe that man is infected from diseased cattle through the medium of contaminated grain, while others hold that the parasite, which is found in the mouth about

septic teeth, gains entrance to the body through an abrasion in the intestinal or respiratory tract.

In thoracic actinomycosis the outlook is bad, the great majority of the patients dying.

Treatment.—The medical treatment of actinomycosis consists in the administration of large doses of potassium iodide; 1 to 4 drachms may be given daily. A vaccine has been prepared from fragments of the mycelium, and its use should be considered in every case. Where the lesion is small, or, in the case of larger lesions where the drainage is good, this treatment has met with some success. Abscesses or sinuses may demand surgical interference, though medical treatment should not be omitted in such cases.

PULMONARY ASPERGILLOSIS

It sometimes happens that in a case which is clinically one of pulmonary tuberculosis, the sputum is found to contain not tubercle bacilli but the aspergillus fungus. Such cases occur among pigeon dealers, who have been in close contact with grain affected by this fungus. The disease is very rare, and the diagnosis involves the exclusion of commoner lung affections. The symptoms and signs are those of pulmonary tuberculosis, including hæmoptysis, cavitation, and fibrosis. In the treatment of this condition cod-liver oil, arsenic, and potassium iodide have proved beneficial. The organism appears in the sputum as a branched mycelium, usually bearing spores—either *Aspergillus fungatus* or *Aspergillus*

niger. It should not be forgotten that aspergillosis may occur as a secondary affection in lung conditions such as tuberculosis or bronchiectasis.

HYDATID DISEASE OF THE LUNG

Hydatid of the lung, though not uncommon in some countries like Australia, is a rare disease in Britain. It is due to the ingestion of the ovum of the tapeworm, *Tænia echinococcus*, the adult form of which is found in the alimentary canal of dogs, but does not occur in man. Infection is conveyed from dog to man either directly by contact or indirectly by the consumption of unwashed green vegetables, such as watercress, which have been grown in polluted water. The possibility of air-borne ova being directly inhaled has also been suggested. In the human alimentary canal the chitinous envelope of the ovum is dissolved, and the six-hooked embryo, thus liberated, then makes its way through the gut wall to infect other organs. It reaches the lungs *via* the portal vein and the pulmonary artery. In the lung it is at first a small rounded body, its hooklets having been shed. It gradually increases in size, its contents liquefy, and its wall is differentiated into two layers. The outer is the laminated ectocyst, and the inner the granular parenchymatous endocyst, from which, as in hydatids elsewhere, secondary daughter cysts may be formed. Round such a growing cyst the compressed pulmonary tissues form an adventitious capsule, more or less well defined.

Symptoms and Signs.—As long as the cyst is small, symptoms are absent and the general health is unaffected. As it increases in size a dry cough may be noticed, which is sometimes paroxysmal in character. Dyspnœa may be present, and pain may be complained of if the cyst involves the pleura. Small hæmoptyses are not infrequent, as a result of congestion of the lung tissue caused by pressure of the growing cyst. It is remarkable, however, that even in the case of a large cyst of the lung pressure symptoms are not prominent, as compared with those caused by other intrathoracic tumours of the same size. Indeed, advanced and extensive hydatid disease involving both lungs may be almost symptomless, and the true condition may not be suspected until rupture occurs or until the appearance of hæmoptysis leads to a complete examination, including the taking of a skiagram. The clinical picture may be complicated by symptoms due to hydatid involvement of other organs. Rupture of the cyst into a bronchus is accompanied by marked dyspnœa, violent cough, pain, a watery bloodstained expectoration, and perhaps by urticaria. Such a rupture may immediately prove fatal, but in other cases the symptoms are less dramatic, and the chief complaint is the expectoration of an unusually large amount of watery phlegm with a notably bad taste. In other cases the cyst may point and rupture externally. Rupture into the pleural sac may resemble spontaneous pneumothorax. If the patient survives the rupture, the symptoms gradually abate, and the cyst wall may

then be expectorated in shreds. In other cases infection of the capsule results in pulmonary abscess with characteristically fœtid sputum, and accompanied by a more or less marked decline in the general health. Some such cases closely resemble pulmonary tuberculosis ; or the symptoms may be less severe, consisting of cough and expectoration, with perhaps attacks of urgent dyspnœa, when shreds of the cyst wall are expelled.

A small or deeply placed cyst yields no physical signs at all. If the cyst is large and near the chest wall there is impairment of the percussion note with reduction of respiratory murmur and diminution of vocal fremitus. Râles or rhonchi may be heard over the affected lung. In some cases it may be possible to demonstrate the rounded outline of the dull area by percussion. Where the cyst involves the pleura, the physical signs are those of thickened pleura or of pleurisy with effusion, but the extreme base is usually resonant. The cyst in its further progress may push its way between the ribs, and form a rounded tumour on the chest wall, by percussion of which it may be possible in rare cases to elicit the so-called hydatid thrill. Displacement of the apex beat may be produced by a growing cyst, and this fact has sometimes proved of diagnostic value. After rupture the physical signs may be those of cavitation, and may be accompanied by more or less impairment of the general health, so that the condition may simulate tuberculosis, bronchiectasis, or pulmonary abscess. In other cases the general health remains good, the signs of

cavitation cannot be demonstrated, and adventitious sounds are absent or are those of bronchitis.

Diagnosis.—Hydatid of the lung is a rare disease, but it ought to be considered in all cases where the symptoms or signs are anomalous, especially in cases of unexplained slight hæmoptysis or of atypical pleurisy. The patient may, or may not, give a history of close association with dogs. Neither the symptoms nor the physical signs are characteristic, and unless rupture has occurred a definite diagnosis can rarely be made on the physical examination alone. Once the suspicion of hydatid has been raised, a skiagram of the chest should be taken. The presence of a cyst is shown by a relatively dense round or oval shadow sharply differentiated from the surrounding lung. Usually the disease affects the lower lobe, and it is more common in the right lung than in the left. Cysts may be present in both lungs, and involvement of the liver is sometimes shown by an irregular contour of the diaphragm on the right side. When the cyst has ruptured, the demonstration of hooklets or of portions of the laminated cyst wall in the sputum serves to establish the diagnosis, and in such cases the X-ray picture may not be typical. Hydatid disease is accompanied by eosinophilia in a large percentage of cases, a fact which has some diagnostic value. The complement fixation test has also been successfully employed as an aid to diagnosis, the antigen used being an extract of a hydatid cyst wall.

Before rupture, hydatid cyst may have to be differentiated from pulmonary tuberculosis, intra-

thoracic tumour, aneurysm, encysted empyema, pleural thickening, pleural effusion, and bronchiectasis. At the time of rupture the symptoms may suggest pneumothorax or acute pulmonary œdema. After rupture the disease may simulate bronchitis, tuberculosis, bronchiectasis, abscess, or gangrene. In the differential diagnosis the skiagram and repeated sputum examination are the most helpful measures, though the presence of eosinophilia should be sought for, and the complement deviation test applied. A careful search should be made for evidence of hydatid disease in other organs, especially the liver. In the investigation of a case of possible hydatid disease of the lung, it is most important that the exploring needle should not be used, for such a procedure has led to fatal suffocation by the discharge of hydatid fluid into the lung tissue.

Treatment.—Hydatid disease of the lung is hardly ever cut short by death of the cyst and subsequent inspissation of its contents. When the disease is diagnosed before rupture, the treatment is surgical, and consists in incising and evacuating the cyst. When spontaneous rupture has occurred, the treatment is symptomatic, but if suppuration develops in the cyst cavity, and the patient does not respond to medical measures, the question of artificial pneumothorax should be considered, and in some cases it may be necessary to open and drain the cavity. The treatment of hydatid of the pleura is surgical, and consists of resection of a rib and evacuation of the contents of the cyst.

CHAPTER X

PNEUMONIA

PNEUMONIA, or acute inflammation of the lung substance, has two recognised forms :

I. Lobar Pneumonia.

II. Lobular Pneumonia or Broncho-pneumonia.

The so-called chronic interstitial pneumonia is an affection of the lungs characterised by a permanent increase in the fibrous tissue. It may be due to a previous attack of acute pneumonia, or may arise from other causes.

I. LOBAR PNEUMONIA

Lobar pneumonia is an acute specific infection due to the pneumococcus of Fränkel. In its typical form it is characterised by inflammation of one or more lobes of the lung, and by pyrexia, which is of limited duration and which terminates by crisis. The lung condition is to be regarded as a localisation of the general infection.

Bacteriology.—In association with the pneumococcus other organisms are frequently found. Among these are the streptococcus, the micrococcus catarrhalis, the bacillus of influenza, and the pneumobacillus of Friedländer. Pneumonia developing during the course of diphtheria or typhoid

fever may show the presence in the lung of the specific bacilli of these diseases in addition to the pneumococcus. Such organisms usually play a secondary rôle, but, in the broncho-pneumonia of influenza, the streptococcus is often the predominant organism, and is responsible for the graver features of the disease. Occasionally lobar inflammation of the lung is due to the pneumobacillus alone. It has been shown that the pneumococcus is a normal inhabitant of the upper respiratory tract, and its pathogenic power in an individual must therefore depend upon conditions which exalt its virulence or lower his resistance.

Investigations at the Rockefeller Institute have led to the differentiation of four types of pneumococci. Types 1 and 2 cause the majority of cases of pneumonia. Type 2 is found less commonly than Type 1; both are of high virulence for man, especially Type 2. Type 3 accounts for 12 per cent. of cases, and has a mortality of 45 per cent. Type 4 causes nearly one-quarter of the cases, with a mortality of 16 per cent. Monovalent antisera have been prepared from each of these strains, and have been used intravenously in the treatment of the disease. Decrease in the mortality rate has been reported from the use of Type 1 antiserum in America. In pneumonia due to other types antiserum therapy has been much less successful. A prime condition of success is that the case should be seen early, and that the pneumococcus should be isolated from the sputum and typed as soon as possible.

Pneumonia is a disease of increasing importance in civilised life, and many of its victims are cut down in their prime. Usually sporadic in occurrence, it sometimes assumes epidemic proportions, *e.g.*, when following in the wake of influenza, and its mortality may then amount to as much as 5 per thousand of the population in the area affected. In the year 1925 pneumonia in its various forms was responsible for 36,990 deaths in England and Wales. Some observers believe that the disease is altering its character, and that the classical type of lobar pneumonia, with its well-defined onset, course, and crisis, and its definitely lobar distribution, is relatively less common than it was.

Ætiology. — *Predisposing Causes.* — Depressed vitality in the individual, from whatever cause arising, renders him more likely to contract pneumonia. Among the predisposing factors are exposure, overcrowding, intemperance, malnutrition, and idiosyncrasy. Pre-existing disease, such as nephritis, diabetes, cardiac disease, favours its onset. The immunity conferred by one attack is short-lived, and persons who are predisposed to pneumonia may have many attacks during their lives.

Pneumonia is most prevalent in the autumn and spring months, the maximum mortality occurring in November. During the summer months it is comparatively rare. Prolonged exposure to cold during muscular exertion is the history found in many cases. Great variation in the temperature from heat to cold, particularly if associated with strong winds, seems especially to provoke an attack.

Many patients refer their illness to exposure to draughts. The disease is more common among town dwellers than among dwellers in the country, a fact which is probably due to differences in atmosphere, occupation, and habits. Dusty occupations, which favour the development of respiratory catarrh, also predispose to pneumonia. In a few cases trauma of the chest wall appears to have been the exciting cause, while the debilitating influence of shock has proved the determining factor in certain cases of injury of other parts of the body.

Males are more often affected than females, the proportion being about two to one. The explanation of this is probably to be found in differences of habits and occupation, since, when the sexes are under similar conditions, the disparity disappears. Before puberty the difference in the incidence between the sexes is not marked. In childhood the disease increases in frequency up to the sixth year ; it then declines till puberty, after which it again increases.

Pneumonia is usually a unilateral disease, and the right lung is more often affected than the left. In the great majority of cases it is the lower lobe that is involved, and this basal distribution is the rule also in case of double pneumonia. In adults apical pneumonia is not common, and pneumonia affecting both apices is very rare. In young children, however, apical pneumonia is not infrequent, the disease being confined to the upper lobe in about one-third of the cases. Central pneumonia, on the whole rare, is relatively common in old people.

Symptoms and Signs.—The *onset* of the disease is typically sudden and is marked by a definite rigor, which is not repeated, and which may last from a few minutes to half an hour. If such a rigor occurs in a person previously healthy, and is accompanied by severe pleuritic pain, the diagnosis of pneumonia is practically certain. One should always seek for the history of such a rigor, as it forms a definite point from which to date the illness. Apart from such a rigor, the onset of pneumonia may be heralded by vague feelings of malaise, and the patient may complain of feeling shivery, as if cold water were being poured down his back. Such insidious invasions are especially found when the pneumonia is secondary to some other pyrexial disorder. They are also common in the aged, the insane, and the alcoholic, and they may also be found in traumatic cases. Often the most prominent feature of the onset is pain, usually situated over the affected area of the lung; but careful questioning will often elicit a history of feeling out of sorts for a few days previously, a fact which the pain has made the patient forget. Such pain is not always localised over the lung, but may be referred to distant areas. In diaphragmatic pleurisy, for instance, it may be felt in one or other shoulder or in some part of the abdomen, *e.g.*, over the appendix. It has been a feature of some recent epidemics that the pleural pain has been a late symptom of the disease, because the pneumonia has begun centrally and spread towards the periphery. It will thus be seen that the onset of pneumonia may simulate an

acute abdominal condition, and this fact has led to operations being performed under such mistaken diagnoses as perforated gastric ulcer or acute appendicitis. A history of cough, however slight, or the presence of herpes about the mouth, is very suggestive of pneumonia and should call for a careful examination of the chest. Rusty sputum, if present, is practically pathognomonic of lobar pneumonia. The pulse respiration ratio is here of the greatest diagnostic importance. A history of vomiting is in favour of a surgical condition, though vomiting may occur at the onset of pneumonia, especially in children. In the young also, the onset of pneumonia may be marked by convulsions, which represent the initial rigor of the adult patient. Among the less frequent symptoms of onset may be mentioned epistaxis and hæmoptysis, while in some adults there is aching in the lumbar region, which may be severe enough to suggest small-pox.

Inspection.—Lobar pneumonia is typically sudden in its onset, and when the disease is once established it is obvious that the patient is already acutely ill. The face is flushed, the eyes are bright, the skin is hot and often dry. Labial herpes is present in many cases. The breathing is rapid and may be noiseless, though in some cases expiration is accompanied by a short grunting sound. The alæ nasi are often visibly active. The cough is short, dry, and frequent, being usually restrained on account of the pleuritic pain. In rare cases there may be no cough throughout the disease. Sooner or later the characteristic sputum makes its appearance in a great

majority of cases. It is at first scanty and very tenacious, so that it is expectorated with difficulty and clings to the sputum cup when that is inverted.

Its colour varies. It may be hæmorrhagic from the admixture of fresh blood, but it is usually more or less rusty from the presence of altered blood pigment. After a few days the rusty appearance passes off and the sputum becomes muco-purulent, but sometimes the rusty character is maintained throughout. In the more advanced stages, especially when the disease is taking an unfavourable course, the sputum may be thin, watery, and brownish red—the so-called prune-juice sputum. In a few cases, especially in children and old people, no sputum may be expectorated ; in the aged we do not look upon this as necessarily a bad sign. The expression of the patient's face is usually one of anxiety, and in his endeavour to lessen the pain he may keep his hand pressed to the affected side, may lie upon that side, or may curve his spine towards it, so as to bring his ribs closer together. Some degree of immobility of the affected side may be noticed from the first, though this is not usually apparent till the later stages of the disease.

Palpation.—Palpation will reveal diminished movement of the affected side, and in some cases a pleuritic friction rub may be palpable over the affected pleura. When the stage of consolidation is reached, vocal fremitus is found to be increased over the pneumonic lung.

Percussion.—In the early stage, percussion findings are negative, but, when the disease is estab-

lished, we get a percussion note which is dull, but which is accompanied by a peculiarly resilient feel under the finger as compared with that experienced over fluid effusion. It is quite possible to find nothing abnormal on percussion, even when there is a history of pleuritic pain or when the sputum is characteristic. In the early stages of so-called central pneumonia, for instance, percussion is negative, but later reveals an area of dulness which gradually increases in size and intensity.

Auscultation.—At the outset auscultatory signs are often absent. Sometimes the ordinary breath-sounds may not be heard. In many cases this is a most characteristic early sign. Plugging of the alveoli, or even lobular collapse, is its probable cause. The most typical early sign is the fine crepitation, which is heard only during the inspiratory phase, and which has been aptly likened to the sound made by rolling between the fingers a lock of hair near the ear. This fine crepitant râle is rarely, if ever, heard in any other lung condition. It corresponds to the stage of congestion, and disappears when the lung becomes consolidated. As the inflammatory exudation increases, the breath-sounds approximate to the bronchial, and when consolidation is complete, the breathing is typically high pitched and tubular. This tubular breathing varies in intensity; it is usually loud, but not harsh, but it is sometimes soft, blowing, and distant. It is due to the transmission of the glottic breath-sounds through the solidified lung.

At the onset of the disease auscultation will often reveal the presence of pleuritic friction, which may be either coarse or fine. Some authorities believe that the typical crepitant râle of pneumonia is really pleuritic in origin, but others hold that it is caused by the separation of the walls of the alveoli and finer bronchioles in the presence of exudation.

Over the consolidated area vocal resonance is increased and bronchophony is often marked. When resolution commences after the crisis, râles and rhonchi of all sizes may become audible. In other cases the only adventitious sound is the redux crepitation, which is larger and coarser than the fine crepitation of the engorgement stage. Not infrequently resolution occurs without any râles or rhonchi appearing, the tubular breathing gradually giving place to the ordinary vesicular murmur. Before normal is reached, a stage may be arrived at in which the respiratory murmur is puerile. Where two separate areas in the lungs are successively involved, one may yield signs of resolution while the signs in the other still indicate consolidation, or even the earlier stage of engorgement. As a rule, the physical signs clear up in about a week from the crisis, with the exception of impairment of the percussion note, which may persist for weeks or months, and may be accompanied by reduction of the respiratory murmur. In children, resolution may take place in two or three days.

Temperature in Pneumonia.—The sudden onset of pneumonia is accompanied by a rapid development of pyrexia. During the initial rigor the

temperature is rising rapidly, and within a few hours thereafter it may reach 104° F. Once the pyrexia is established, it remains strikingly constant in a typical case, the evening temperature being only about a degree higher than the morning. In elderly people, in alcoholics, and in cases where pneumonia has supervened on some pre-existing disease, the rise of temperature is not so rapid and the degree of fever is not so high. In rare cases, usually in old or debilitated subjects, the disease is afebrile. The crisis, a dramatic and characteristic feature of pneumonia, usually occurs about the seventh day, though it may take place at any time between the third and the twelfth. As a rule, it is complete before the ninth day. At the crisis the temperature falls to normal or below normal within about twelve hours. This fall is usually accompanied by profound sweating, and perhaps by diuresis and diarrhœa. In most patients the crisis begins in the night or the early morning. In favourable cases the completion of the crisis is attended by a marked improvement in the patient's condition, both subjectively and objectively. He feels much more comfortable, his distress disappears, and his sleep and appetite begin to improve. It is noteworthy that this marked improvement is not usually accompanied by any alteration in the physical signs, for the crisis marks the turning-point in the battle against the general toxæmia rather than a local change in the lung condition. At the crisis the respiration rate and the pulse rate fall with the temperature. Not infrequently the

approach of the crisis is heralded by a pre-critical rise of temperature of one or two degrees. A so-called pseudo-crisis is fairly common; a day or two before the true crisis the temperature falls abruptly for two or three degrees and then rises again. After the crisis there may be a rise of a degree or two on the following day, but, if this persists, and if the chart assumes a remittent character, the presence of empyema should be suspected. Where the pneumonic process is subsiding in one lung and spreading in another, there may be a drop in the temperature similar to that shown in the pseudo-crisis. After this it may rise as high as before, and physical signs of the fresh pneumonic area may then be detected. The duration of this second pneumonic process is usually shorter than that of the first.

Abortive pneumonia is the term applied to cases occasionally met with which terminate by crisis or lysis several days before defervescence is expected to occur. Termination by lysis is more common in cases which have been prolonged beyond the time at which the crisis usually happens; it is not infrequent in children.

The Cardiovascular System in Pneumonia.—At the outset the pulse rate is moderately increased and the pulse respiration ratio falls from the normal 4 to 1 to 3 to 1 or less. In cases which are doing well, the pulse rate does not exceed 120 per minute, though in children, in old and feeble patients, and in a few adults whose pulses are naturally rapid, the rate may be high throughout the attack.

Dicrotism is rare. During the febrile period the pulse remains full and strong in satisfactory cases, though some irregularity is not uncommon towards the time of the crisis. As the disease advances, the blood pressure may fall from 10 to 20 mms. of mercury. A larger fall than this suggests circulatory failure. The heart-sounds are loud and clear, the second pulmonic sound being distinctly accentuated; disappearance of this accentuation marks the beginning of cardiac failure, which is also suggested by loss of tone and volume of the first mitral sound. Systolic murmurs may be heard in the mitral and pulmonic areas throughout the illness.

Lobar pneumonia is usually accompanied by an increase in the number of the polymorpho-nuclear cells of the blood, the leucocytosis being from 10,000 to 30,000 per c.mm. Absence of leucocytosis is to be considered serious. Where possible, white cell counts should be made at regular intervals during the course of the disease.

The Alimentary System in Pneumonia.— Vomiting may be an initial symptom, especially in children, and during the course of the disease it may be induced by severe paroxysms of coughing. The tongue is furred, and there is loss of appetite. In serious cases the tongue is persistently dry, and, in these, moistening of the tip may be an early sign of a change for the better. Constipation is the rule. Meteorism may develop, especially in toxæmic cases. It may do harm by mechanically preventing the efficient respiratory action of the diaphragm.

The liver, as a rule, is appreciably enlarged, but the spleen is seldom palpable.

The Nervous System in Pneumonia.—Headache is common at the beginning, and in children the onset may be marked by convulsions. Giddiness, delirium, and tremor are other symptoms of the toxæmic state. In alcoholics delirium tremens may occur before or after the crisis; when it appears early, the lung condition is easily overlooked. Symptoms of acute mania may appear during convalescence, and delusions follow. We had one case of acute transverse myelitis developing after pneumonia. In markedly toxæmic cases the ordinary lung symptoms may not be at all prominent, but the patient is profoundly prostrate in a quiet delirium. Fulminant cases occur with active delirium and marked toxæmia, in which the extremely rapid pulse and respiration rates are ominous from the outset. Insomnia is a common and very intractable symptom.

The Skin in Pneumonia.—The skin is hot and dry, though a moist skin is not unknown—a fact which in some cases is due to the action of diaphoretic drugs. Sweats attend or slightly precede the crisis; following the crisis, they often mean empyema.

Herpes in the oro-nasal region is present in a large percentage of cases; it usually appears at the beginning of the illness, but may occur later, and is not to be regarded as a bad sign.

The Urine in Pneumonia.—Febrile albuminuria is common, but definite nephritis is very

rare. There is marked diminution or even absence of the chlorides in the urine. A concentrated, acid, high-coloured urine is the rule, and in some cases it has a peculiar orange colour, which bears no relation to the degree of concentration, and which is almost diagnostic of the disease.

Clinical Varieties of Lobar Pneumonia.—In addition to the ordinary form of lobar pneumonia just described, other varieties are commonly recognised. Some of these are based on the anatomical distribution of the lesion, *e.g.*, apical, creeping, double, central, and massive.

Apical Pneumonia, relatively uncommon in adults, is somewhat more frequent in children, and for this reason, perhaps, it is more often marked by severe cerebral symptoms than is the ordinary basal form.

Creeping or Migratory Pneumonia is marked by the successive involvement of two or more lobes.

Double Pneumonia is usually basal, and has no other special characters.

Central Pneumonia. — Here the inflammatory process begins at a considerable distance from the surface, and the physical signs of the disease may not be appreciable for several days. This variety is not uncommon in the aged, in whom it may be afebrile. In some cases pleuritic pain is complained of only towards the end of the process, when the disease reaches the periphery.

Massive Pneumonia.—In massive pneumonia the bronchi are plugged with fibrinous exudate. The

consequent absence of auscultatory phenomena strongly suggests pleuritic effusion, but there is no marked displacement of the viscera, and exploratory puncture is negative.

Apart from anatomical peculiarities, lobar pneumonia may present certain special features for which distinctive terms have been employed:

Alcoholic Pneumonia.—In alcoholics the onset and course of the disease tend to be insidious, and the physical signs are often vague. Delirium is common, and the pneumonia is easily overlooked. Alcoholics stand pneumonia badly.

Terminal Pneumonia.—Pneumonia is not infrequently the immediate cause of death in patients suffering from chronic disease of the heart, arteries, or kidneys, or from constitutional disorders such as diabetes. The condition may not be recognised during life as the patient is too ill for a thorough examination, and the signs and symptoms are not marked.

Latent Pneumonia.—This term is applied to various forms of the disease among which are the insidious varieties we have described as occurring in those debilitated by chronic disease, in alcoholics, and in the insane. In people who have been previously healthy a total absence of physical signs occasionally coexists with symptoms which are characteristic of pneumonia, such as rusty sputum and pyrexia. The pneumonia in these cases may be central in character.

Secondary Pneumonias occur in the course of specific infections like typhoid fever, measles,

whooping-cough, diphtheria, and influenza, and are as a rule lobular and not lobar.

Epidemic Pneumonia indicates the limited outbreaks which sometimes occur in households, institutions, or wider areas. Epidemic pneumonia is frequently an accompaniment of epidemic influenza, and is then not a primary pneumonia ; moreover, it is usually lobular in character. In rare instances lobar pneumonia may spread from one person to another by direct contagion.

Abortive or *Larval Pneumonia* is characterised by a short course and ill-developed symptoms.

Toxic Pneumonia, also called asthenic or typhoid pneumonia, presents marked evidences of general toxæmia, while the local signs of disease are ill defined. There is great prostration and delirium, and the presence of jaundice, diarrhœa, and meteorism may suggest the diagnosis of typhoid fever. The condition is probably a pneumococcal septicæmia.

Post-operative, Anæsthetic, or Ether Pneumonia.— This is generally lobular rather than lobar in character. It may be caused by the inhalation during anæsthesia of saliva or food particles from the mouth, the so-called inhalation pneumonia. Post-operative pneumonia may be simulated by pulmonary embolism or pulmonary collapse. After abdominal operations particularly, the interference with the diaphragm and the low state of the circulation predispose to hypostatic congestion at the bases in debilitated patients who maintain the recumbent posture for a long time. This is not a true lobar pneumonia, but is rather a form of con-

gestion due to physical conditions and only secondarily to bacterial invasion. When well developed it constitutes the so-called *hypostatic* pneumonia.

Pneumonia and Age.—In children, lobar pneumonia is less commonly limited to one lobe than in adults, and is not infrequently ushered in by a convulsion. Herpes is rare, while empyema is relatively common. Rusty sputum is rare. Termination by lysis is more common than in adults. In children, lobar pneumonia is a benign disease.

Pneumonia in the aged is a very fatal affection. All the features of the disease, including the onset, symptoms, and physical signs, are much less pronounced than in younger patients, while prostration is usually severe.

Diagnosis.—The onset of pneumonia in a healthy subject usually presents no diagnostic difficulties. The initial rigor and the marked pleuritic pain, closely followed by the rusty sputum, are characteristic and tell their own tale. The disturbance of the pulse respiration ratio is of value in doubtful cases. We have seen that the onset with abdominal or with meningeal symptoms may lead to error if the case is not carefully examined. Where pneumonia supervenes in patients suffering from some other disease, or in those who are old or alcoholic, its onset may be much less striking, and the lung signs may be easily overlooked unless the physician is on the alert, but a change for the worse in the general condition is usually noticeable.

X-ray examination is rarely justifiable or necessary in the diagnosis of lobar pneumonia, but after

the crisis its use may be essential in discovering an unusually placed empyema or some other cause of delay in recovery.

Pneumonia and Other Diseases.—*Tuberculosis.*—Lobar pneumonia is very rarely indeed either a complication or a terminal event in pulmonary tuberculosis. In a previously healthy person lobar pneumonia never directly gives rise to tuberculosis. The rare condition of acute tuberculous pneumonia can be differentiated from acute lobar pneumonia only when the crisis fails to appear and signs of breaking down of lung tissue develop.

Chronic Bronchitis.—Pneumonia is not an infrequent terminal condition in chronic bronchitis. Where lobar pneumonia develops in a patient suffering from chronic bronchitis and emphysema the outlook is considerably worse than in a previously healthy person. In some cases during the height of the pneumonia the bronchitic signs largely disappear—a fact which forms a favourable element in prognosis.

Influenza.—Pneumonia occurring in the course of influenza is usually of the lobular variety, though lobar pneumonia also occurs.

Typhoid Fever.—In "pneumo-typhoid" all the signs and symptoms of lobar pneumonia may be found, but pneumonia complicating typhoid is as a rule a broncho-pneumonia, and the same is true of pneumonia secondary to other infective diseases such as measles and whooping-cough.

Complications.—*Pleurisy.*—Pleurisy in its fibrinous form is present to some extent in the majority

of cases, being a part of the lung inflammation rather than a complication. It may add greatly to the suffering of a patient. Where it proceeds to effusion, the exudate usually becomes purulent, and empyema thus formed is the most common of all the complications of pneumonia. In an adult an unusually severe initial pleurisy seems to favour the development of empyema.

Empyema.—In adults, empyema appears as a complication in about 4 per cent. of all cases ; in children, it is nearly three times as common. The occurrence of this complication is often first indicated by a rise in the temperature and pulse ; the respiration rate may also be increased or may remain for a time without much alteration. The usual features of the crisis are not well marked, or, if the crisis has occurred, the temperature rises again within three or four days. The patient does not improve, and may complain of recurrence of the pleuritic pain. Profuse sweatings may now appear for the first time during the illness. Leucocytosis persists or increases, while the cough may become more troublesome, and perhaps paroxysmal. With such symptoms the physical signs of effusion are usually definite, and the suspected area must be explored with a good-sized needle attached to a syringe. Several punctures may be necessary before pus is located. The sitting position is the most satisfactory if the patient is fit for it. Occasionally a suitable site for puncture is indicated by the presence of a small patch of subcutaneous œdema. When the empyema is free at the base,

the puncture is usually made in the space below the inferior angle of the scapula and just external to the scapular line, the needle being steadily inserted immediately over the upper border of the rib.

In the great majority of cases the organism found in the pleural exudate is the pneumococcus. Streptococcal empyema complicating lobar pneumonia is much less common but is more grave. As compared with the thick pus of the pneumococcus, that of the streptococcus is often thin, and may look only doubtfully purulent—a fact which should not lead the practitioner to dismiss the question of operation.

It occasionally happens that empyema develops not over the base of the lung, but between two lobes or on the diaphragmatic surface. The physical signs of such conditions are ill-marked or absent according to the amount of pus and the depth at which it lies. Where symptoms of empyema are present, X-ray examination usually, but not always, indicates the situation of the exudate. Apart from this, the condition is often overlooked, and the first sign of empyema is the expectoration of a large amount of purulent sputum when rupture takes place into a bronchus. In other cases, where such rupture does not occur, death may result, and the condition be recognised only post-mortem.

Bronchitis.—Bronchitis is not a common complication of lobar pneumonia. When it appears to be such, the patient will usually be found to have been a sufferer from chronic bronchitis. The

presence of bronchitis as a complication distinctly increases the gravity of the illness.

Pericarditis. — Pericarditis is not uncommon, though its presence is often detected only at autopsy, since the majority of those affected die. On the other hand, it is often diagnosed when not present, especially when, in the presence of pleurisy, the friction rub in the præcordial area takes on cardiac rhythm. Pericarditis is more likely to occur when pleurisy has been a well-marked feature. In a small percentage of cases the inflammation proceeds to purulent effusion—pyo-pericardium.

Neither the signs nor the symptoms of this condition may be at all marked, but if its presence is suspected from physical or other examination, an exploring needle should be inserted in the left fifth space, either one to one and a half inches to the left of the sternal border, or at the left border of the cardiac dulness, if that can be determined ; if this is not possible, then in, or just external to, the left nipple line. If pus is found, the further treatment is surgical, and consists in free drainage of the pericardial cavity.

Endocarditis.—Acute endocarditis, usually of the ulcerative type, is not a common complication, and is more likely to occur in patients who have previously suffered from valvular disease. Cases of primary ulcerative pneumococcal endocarditis do, however, occur, though neither the symptoms nor the signs may be at all marked. Temporary systolic murmurs are not uncommon in pneumonia as in other fevers, and should not be regarded as

necessarily meaning structural disease; but the development under observation of a diastolic murmur is very strong evidence of endocardial involvement.

Meningitis.—Meningitis, a grave complication, is very rare in adults, but commoner in children. It may accompany endocarditis in a patient suffering from pneumococcal septicæmia, or it may be the only manifestation of such a pneumococcal infection. Typical symptoms of meningitis may not appear until the base of the brain is involved. Meningism is not infrequent, especially in children, and may closely simulate meningitis, but its symptoms appear early and are transient. Lumbar puncture excludes the graver condition. In children and young adults tuberculous meningitis may develop after an attack of pneumonia.

Arthritis.—This is a rare complication. It may precede, accompany, or follow the development of physical signs in the lungs. It affects one or more of the large joints. The more acute cases proceed to suppuration, and demand surgical treatment. Non-suppurative cases are very intractable. Vaccine treatment sometimes distinctly hastens recovery.

Otitis Media.—This complication develops in a small proportion of cases, and, like arthritis, is more common in children. It may be overlooked, as its onset is often insidious. When, therefore, the course of pneumonia in a child is not satisfactory for some unexplained reason, the possibility of otitis media should always be remembered, and the tympanic membrane examined.

Peritonitis.—Peritonitis, a rare complication, may be quite insidious in onset, and may develop without abdominal distension. Its appearance means a serious case, though it should be carefully differentiated from the more common meteorism. Other local evidences of pneumococcal infection, *e.g.*, otitis media, may accompany it. Sometimes it appears during convalescence. Its presence means a grave prognosis. The treatment is surgical. It should not be forgotten that primary pneumococcal peritonitis, without any lung involvement, is sometimes found.

Jaundice.—This is not common. Where it is evidence of a local catarrh the prognosis is not materially affected. When it occurs in a septicæmic case the outlook is of the gravest. Its incidence varies considerably in different epidemics.

Thrombosis.—Thrombosis, usually in the femoral vein, occasionally occurs, especially in old or debilitated subjects. If the thrombus spreads upwards into the abdominal veins, the outlook is very grave.

Among rarer complications may be mentioned peripheral neuritis, parotitis, colitis, and nephritis. One of us had a case of pneumonia, a man of 30, who developed transverse myelitis, and lived three years. Hyperpyrexia is occasionally found.

Terminations of Pneumonia.—Where lobar pneumonia is not directly fatal it may terminate in one of several ways. In the majority of cases resolution proceeds uneventually after defervescence. Usually the lung signs persist after the fall

in temperature, but within a week or so they disappear, though appreciable dulness due to the pleural thickening may continue for weeks. The inflammatory exudate in the alveoli is mainly got rid of by absorption, and not by expectoration.

Delayed Resolution.—In a small percentage of cases, especially when the patient is alcoholic or debilitated, physical signs may persist over one lobe or part of a lobe, so that tuberculous disintegration of the lung is simulated. Sputum examination for tubercle bacilli is negative, and after several weeks the resolution of the affected lung is usually completed. In all such cases it is important to exclude empyema. In some instances, however, the lung shows permanent traces of previous inflammation in the form of some degree of dulness and reduction of respiratory murmur, with, it may be, persistent crepitations ; these signs may vary in intensity from time to time.

Chronic Interstitial Pneumonia.—In rare cases of unresolved pneumonia the affected lung gradually passes into a condition of chronic fibrosis. Physical examination reveals contraction of the lung, dulness, râles, and reduction of respiratory murmur. The apex beat is usually displaced. Ultimately the condition may pass into one of bronchiectasis.

Abscess of the Lung.—This is a rare termination of pneumonia. As a rule, it is single, but the single cavity may have resulted from a fusion of smaller foci. The onset is usually insidious. When free communication is established, the sputum becomes purulent and later commonly fœtid, and contains

elastic tissue. Cough is troublesome and occurs in paroxysms. There is fever of a remittent type. The condition may be recognised by X-ray examination, though the differentiation of such an abscess from a localised empyema escaping through a bronchus is not always easy, especially if the abscess cavity contains air.

Gangrene of the Lung.—Gangrene of the lung is also a rare termination of lobar pneumonia. It is more likely to occur in patients who are debilitated, alcoholic, or insane. It results from interference with the blood supply caused by thrombosis of the vessels. The horribly offensive sputum is usually dark reddish brown or greenish in colour, and it may be shown to contain elastic fibres or even small portions of lung tissue. The condition is usually fatal, but cases occur, especially in children, in which only a minute portion of the lung is affected, and in which recovery ensues.

Diffuse Suppuration or Purulent Infiltration.—This is a fatal termination of pneumonia which derives its name from the condition found at autopsy. It is probably due to a combination of grey hepatisation and pulmonary œdema. Clinically its presence is marked by severe toxæmic symptoms, rigors, sweatings, and purulent sputum. The physical signs are those of a fully developed pneumonia, complicated by coarse liquid râles.

Prognosis.—The mortality directly resulting from lobar pneumonia is usually given as in the region of 20 per cent. In private practice the figure is not so high, but it should be remembered that hospital

patients are often serious cases, and that many of them arrive in a late stage of the disease. Among the factors influencing the prognosis in lobar pneumonia the following are important :

1. *Age.*—In infants, lobar pneumonia is very fatal. In children over two, it rarely causes death. After childhood the mortality increases with the age, so that, of those over 60, one-half die.

2. *Resistance of the Patient as determined by Previous Health and Habits.*—Patients who already suffer from chronic debilitating conditions, such as diabetes, heart disease, or nephritis, have a distinctly worse prognosis than those who have been previously healthy. Poor physique and malnutrition are also unfavourable factors, though it should be noted that very fat persons stand pneumonia badly. A history of chronic alcoholism undoubtedly increases the chances of death to a very marked degree.

3. *Character of the Pneumonia.*—The more marked the toxæmic features the worse the outlook. Nervous symptoms, for instance, such as delirium, insomnia, and tremor, are of bad import. Meteorism is also unfavourable, since it not only indicates toxæmia but mechanically impedes the action of the diaphragm. Unfavourable also are extremes of temperature, either in the form of hyperpyrexia or of low temperature accompanied by other evidences of poor reaction. The condition of the cardio-vascular system is of cardinal importance. Dilatation of the right heart, which may be appreciable by percussion and which may be heralded by

loss of accentuation of the second pulmonary sound or weakening of the first mitral sound, indicates danger. A rapid small pulse of over 130 per minute is a bad sign.

Observations upon the blood pressure in pneumonia provide an indication of the progress of the case. A marked fall is an unfavourable sign, and in cases which are doing well the blood pressure, registered in mm. of mercury, should not fall below the pulse-rate. Cyanosis is unfavourable, and a respiration rate of over 50 per minute is not a good sign. The ratio of the pulse-rate to the respiration rate is of prognostic importance ; when it falls to 2 to 1 the condition of the patient is not satisfactory.

An estimation of the white blood cells is often of value in prognosis. Leucopenia, or even absence of leucocytosis, is a bad sign, indicating, as it does, a poor reaction. A moderate leucocytosis, in the neighbourhood of 25,000, is favourable, though a very high count is not necessarily so. A sudden increase in the number of white cells may indicate the development of some complication, such as empyema.

If the temperature, pulse, and respiration are recorded at four-hourly intervals, the appearance of the chart may be distinctly helpful. When the three curves rise and fall in harmony, all is usually well, but a break in this harmony, *e.g.*, a falling temperature and a rising pulse, may spell danger. Other things being equal, the greater the amount of lung involved the more serious the case, for the

strain upon the heart is proportionately increased. But death practically never happens from simple suffocation due to extensive involvement of the lung, and the great danger in pneumonia, against which we ought always to be on guard, is failure of the heart.

4. *Complications.*—The presence of complications makes the prognosis more serious. Meningitis is always fatal, but at its onset must be carefully distinguished from meningism. Very grave also is pericarditis, endocarditis, or peritonitis. The development of empyema is unfavourable, though less so if the condition is recognised early and is adequately treated. The presence of pregnancy increases the mortality, partly on account of the risk of abortion, which is greater in the later months of pregnancy. Labial herpes is if anything to be looked upon as a good sign. The appearance of watery brownish-red prune-juice sputum is an unfavourable omen. It should be noted that a history of previous attacks of lobar pneumonia does not materially affect the prognosis.

Treatment.—As we have no recognised means of directly curing pneumonia, our treatment must be based on general principles, and is largely symptomatic. Good nursing is the first essential. All through the illness we should remember the supreme importance of protecting the heart. The room should be large, well ventilated, not overcrowded with furniture, and, if possible, not abutting on a noisy thoroughfare. Where the weather and other circumstances permit, and where the friends of

the patient are intelligent, the conditions should approximate as much as possible to those of open-air treatment. For convenience in nursing, a narrow bed is preferable to a broad one, and the bedclothes should not be heavy. In view of the possibility of delirium it is wise to place the bed at some distance from the window. Throughout the twenty-four hours the room temperature must be kept as constant as possible in the neighbourhood of 62° Fahr. The number of visitors should be reduced to a minimum. A gamgee jacket which can be easily removed without disturbing the patient will be found useful, for he should be moved only when absolutely necessary, and should not be over-examined. His chest should be examined by rolling him over on his side, though where skilled assistance is at hand, more rapid and satisfactory examination is possible in certain cases by having him supported in a sitting position. This must obviously be done with discretion. A daily sponge with warm water should be ordered. The diet should be largely fluid and should include plenty of water or other bland drinks, such as lemon or lime juice well diluted, or weak tea. The quantity consumed is more important than the food value of its contents. Bearing this always in mind, one aims at getting the patient to take three pints of milk, or its equivalent in milk foods, in the twenty-four hours. To the milk may be added beaten-up egg, milk-sugar, or some light cereal food. This should be given every two hours in small amounts.

The condition of the alimentary tract demands

careful attention. The mouth and teeth should be kept as clean as possible by the nurse throughout the illness, and a simple alkaline antiseptic mouth-wash may be prescribed. At the beginning of the attack a dose of calomel, 3 to 5 grains for an adult, should be given, followed by a saline aperient next morning. Constipation should be prevented, and for this purpose enemata or saline laxatives are suitable. Violent purging is uncalled for. Where this treatment has been followed, meteorism is less likely to occur, but, if it should develop, it is best met by the administration of ½ to 1 c.c. of pituitrin hypodermically.

Bacterial Therapy.—The prophylactic use of a pneumococcus vaccine seems to confer some immunity which, however, is not of long duration. Such a vaccine sometimes proves serviceable in dealing with limited communities or institutions when pneumonia is prevalent. In dealing with influenza epidemics the use of a mixed vaccine containing the pneumococcus is a rational preventive measure. In the treatment of a pneumonic attack the use of a stock vaccine is rarely beneficial, though in protracted cases, and in those with complications, good results may be obtained. Where time permits, an autogenous preparation is to be preferred. Of the antisera prepared from the four types of pneumococci, only that corresponding to type 1 seems to be definitely helpful in the treatment of pneumonia. It should be given as early as possible, diluted with normal saline, and in repeated eight-hourly doses, intravenously, until the temperature becomes

normal. Before its use the patient should be tested for sensitiveness to serum, and then, if necessary, desensitised.

Symptomatic Treatment. — While the routine administration of drugs in lobar pneumonia is nowadays rightly deprecated, it may be desirable in some cases to prescribe a diaphoretic or expectorant mixture for the patient at the outset. We give below two formulæ in common use, which may be modified in the individual case :

℞ Liq. ammon. acetat., 2 drs.
Tr. nucis vom., ℥ v.
Tr. cardam. co., ℥ xv.
Aq. camph., ad ½ oz.
Every four hours.

℞ Ammon. carb., gr. v.
Ammon. chlor., gr. x.
Ammon. brom., gr. xv.
Ext. glycyrr. liq., ℥ xv.
Aq. ad ½ oz.
Every four hours.

During the course of the disease certain symptoms may demand special attention :

Pain.—The pain of the initial pleurisy may be treated by hot applications, such as linseed poultices, fomentations, or antiphlogistine. Where it is severe enough to prevent sleep, a hypodermic of morphine, $\frac{1}{6}$ to $\frac{1}{4}$ grain for an adult, may be necessary, and may be accompanied by $\frac{1}{100}$ grain atropine sulphate.

Pyrexia.—Unless the temperature regularly exceeds 103·5 F., no special measures need be taken

for its reduction. When it rises above this, regular tepid sponging by a skilled nurse should be the routine. Hyperpyrexia, which is rare, but which may be fatal, should be dealt with rigorously by repeated cold sponging.

Nervous Symptoms. — The nervous symptoms which may demand treatment in lobar pneumonia are insomnia and delirium. The former is often very difficult to deal with. If it is accompanied by a high temperature, tepid sponging may be successful. Alcohol may be tried in the form of whisky—1-ounce doses in, say, 3 ounces of hot water. Paraldehyde in 2-drachm doses repeated as necessary, is a useful drug, especially in alcoholics. When, as often happens, other things fail, the question of giving opium arises. As a general rule, it is safe to give morphine, $\frac{1}{6}$ to $\frac{1}{4}$ grain, to an adult in the early days of the disease, and it then has the advantage of relieving pleuritic pain, which may be mainly responsible for the insomnia. If preferred, it may be given in the safer form of Dover's powder, 10 grains, which is the desirable mode of administration also in the later stages of the disease, should opium in any form be then considered both safe and necessary. It is as a rule unsafe to repeat a hypodermic of morphine.

Delirium.—Delirium sometimes proves a troublesome symptom, especially in alcoholics. Such patients must be carefully watched, as they are prone to get out of bed if left unguarded for a moment. As a rule it is not wise to deprive them of alcohol, which may be given in the form of

champagne or of whisky or brandy diluted not more than one in three. If the delirium is associated with pyrexia, tepid or cold sponging should be tried. Here again paraldehyde is a useful drug, and may be given in repeated doses of 2 drachms, especially in alcoholic cases where the delirium tends to persist for some days after the crisis. When delirium appears in the earlier stages of the disease a hypodermic injection of morphine may be necessary.

Toxæmia.—In toxæmic cases stimulating treatment should be adopted from the outset, and the importance of eliminating the toxins from the body should not be forgotten. The judicious use of alcohol is here often convenient, while digitalis, camphor, strophanthus, or strychnine may be called upon to stimulate the heart. For this purpose also pituitrin may be employed. The bowels should be kept open by saline aperients, and the patient should be encouraged to take plenty of water. Hydrotherapy, in the form of tepid sponging, is a very useful measure, whilst saline injections, given intravenously or by the rectum, often produce distinct improvement, and have, in our experience, occasionally proved the determining factor in recovery.

Cardiac Failure.—In serious or doubtful cases cardiac stimulants should be given from the outset, *e.g.*, tr. digitalis, 10 ℥ four-hourly, or tr. strophanthus, 3 to 5 ℥ on sugar, or diluted only at the time of administration, may be given every six hours. As in toxæmic cases generally, hydrotherapy and alcohol should be employed. Liq. strychninæ in

5 ℥ doses, may be given hypodermically or in water every four hours, while, in an emergency, 2 grains of camphor suspended in olive oil, or an ampoule of coramine, may be administered intramuscularly; a hypodermic injection of pituitrin ½ to 1 c.c. should be tried if there is much abdominal distension, or if the respiratory centre shows signs of failing. If the above measures are unsuccessful, caffeine may be given hypodermically in doses of 1 grain. A suitable formula is—

℞ Caffeinæ, gr. xxx.
Sodii salicyl., gr. xxxv.
Aq. destillat., ad ℥ cc.
Dose ℥ vii. hypodermically.

A somewhat similar formula may now be obtained in ampoules, and caffeine sodium-salicylate and caffeine sodium-benzoate are now procurable; these salts are easily soluble, and the dose of each is 1–4 grains.

When dyspnœa or cyanosis is extreme, the administration of oxygen bubbled through warm alcohol and water may afford much relief. It may be inhaled for ten minutes every hour. Venesection is sometimes helpful.

In spite of all that watchful care can do, fatal syncope will now and then occur. It may be precipitated by a prolonged clinical examination, or by the patient's suddenly getting out of bed in the momentary absence of the nurse; even more disconcerting, though fortunately uncommon, is sudden death during convalescence.

Respiratory Symptoms.—Cough does not as a rule call for special treatment. When it is troublesome, a sedative mixture may be prescribed, such as elixir heroin. c. terpin. hydrat. in 1- to 2-drachm doses. A simple hot drink is often helpful. At the beginning of the disease, if the cough is disturbing the patient's rest, 10 grains of Dover's powder, or even a hypodermic of morphine, may be justifiably given. At the time of the crisis the patient requires very careful watching, as there is then a distinct danger of cardiac or respiratory failure. In respiratory failure, adrenalin ♏ x. or pituitrin ½ c.c. are now usually employed, but, in their absence, full doses of strychnine are of use. The nurse should be instructed to be particularly alert during this time, and to see that the patient has frequent drinks and is kept warm by hot-water bottles. The appearance of any untoward symptom calls for the administration of cardiac stimulants.

The use of alcohol in the treatment of pneumonia has been much debated. In the majority of cases it is not required, and we have merely tried to indicate above the conditions in which we regard its use as justifiable and wise. It should never be employed as a routine method of treatment, but the pros and cons of the individual case should be carefully weighed before it is prescribed, and its effect should be closely watched, as, even with the greatest care in its exhibition, it may prove to have the opposite effect to that which is desired.

Convalescence.—As a rule, convalescence is rapid and uneventful, but, none the less, it should be

carefully supervised. The patient should remain in bed after the crisis for ten days at least, or for a longer period if there have been any unfavourable features. Before discharging a case the physician should assure himself that the lung has satisfactorily resolved. Delay in resolution when it does occur affords a field for the administration of iodine and iodides in various forms, and for the regular use of pulmonary gymnastic exercises. After convalescence a change of air is usually desirable.

BRONCHO-PNEUMONIA

Broncho-pneumonia is an acute inflammation of the lung involving the bronchioles and the alveoli in their immediate vicinity ; hence it is often referred to as capillary bronchitis or lobular pneumonia. It has no constant association with any specific organism. In the primary form of the disease the pneumococcus appears to play a predominant rôle, while in secondary broncho-pneumonia it may be found in association with the pyogenic cocci, the micrococcus catarrhalis, Friedländer's bacillus, etc. The streptococcus is the commonest organism in the septic form of the disease. Among the predisposing causes may be mentioned the inhalation of dust or fumes, anæsthesia, septic conditions of the mouth and throat, and operations on the mouth and trachea. It is most commonly found as a complication of other diseases, notably some of the fevers, in certain of which the specific organism of the fever may be found in the lung lesion, though

usually not alone. Broncho-pneumonia is relatively common at the extremes of life.

Two **types** of the disease are usually described.

Primary broncho-pneumonia, which occurs in young children, closely resembles lobar pneumonia in its sudden onset, in its fall by crisis, and often, also, in its physical signs, so that the lobular character of the inflammation may be recognised only at post mortem. It is a rare disease with a low mortality.

Secondary broncho-pneumonia is much more common. It may arise in connection with acute or chronic diseases, among which may be mentioned the following :

(*a*) Debilitating conditions in children such as rickets and diarrhœa.

(*b*) Debilitating conditions in old age. In old persons broncho-pneumonia not infrequently appears as a complication, often terminal, of cardio-vascular disease or chronic nephritis. In both children and adults, broncho-pneumonia may develop during acute or chronic bronchitis.

(*c*) *Fevers.*—Children with measles or whooping-cough are very prone to develop broncho-pneumonia, which is the commonest and most fatal of the complications of these diseases. Influenzal pneumonia is usually broncho-pneumonic in character. It should not be forgotten that pulmonary tuberculosis has frequently a broncho-pneumonic distribution.

Certain forms of broncho-pneumonia have received special names. *Deglutition* or *aspiration* pneumonia means that the lung condition results

from the unintentional inhalation of food or other matter into the lung. This may happen during operations or in other forms of unconsciousness. The inhaled matter may come from a focus of disease in the larynx or gullet, or even from diseased conditions, including growth, in the lung itself. The irritating action of the anæsthetic vapour may contribute to its onset. This form of pneumonia may also arise in the course of chronic nervous diseases which involve loss of control of the muscles of deglutition or loss of sensitiveness in the larynx, *e.g.*, bulbar paralysis and general paralysis of the insane.

Septic pneumonia means that the lung condition is associated with a general or local septic process, and that the predominant organism in the lung is one of the pyogenic cocci, usually the streptococcus.

Influenzal pneumonia means a pneumonia complicating or following upon an attack of influenza. In its main features it is a septic broncho-pneumonia. In some of the cases the dyspnœa is suffocative in character, even from the outset, and the cyanosis may have a heliotrope tinge.

In the great majority of cases of broncho-pneumonia the infection is from without, *via* the trachea and bronchial tree; but where the lung inflammation is part of a general septic process such as pyæmia or septicæmia, the organism may reach the alveoli by the blood stream.

Symptoms and Signs.—In the common secondary variety of broncho-pneumonia, the condition usually appears insidiously during the course of the primary

illness. It begins as a bronchitis, but the chest symptoms gradually become worse, and the patient's general state becomes more serious. The temperature, respiration, and pulse indicate that the condition is more grave than simple bronchitis. The pyrexia reaches the neighbourhood of 103° F., and shows fluctuations of two or more degrees. It ends by lysis, which should not be expected to occur before the end of the second week, and which may be delayed for another week or more. The pulse is quickened, rising in children to 150 or higher. Dyspnœa is usual, the respiration rate may be 60 or over, the extraordinary muscles of respiration being brought into play. It may be noticed that in some children the respiratory rhythm is disturbed, the pause occurring after the inspiratory phase—the so-called *inverse* type of respiration. Expiration is accompanied by a short grunting sound. Cough is a very variable feature : it may be highly distressing, or it may not be at all marked. In children sputum is not usually available for examination ; in adults it is mucopurulent or purulent. The appearance of the patient varies with the degree of toxæmia. In the severer cases there is cyanosis, lividity, or sallowness, and the lips are dusky.

In young children there is inspiratory retraction of the lower zone of the chest. Percussion may be negative, or may reveal ill-defined areas of impairment. Such areas may be scattered over one lung or both lungs, or the involvement of the lobules may be so circumscribed as to simulate the dulness

of lobar pneumonia. The auscultation signs vary. Medium-sized or fine râles, with perhaps scattered rhonchi of various sizes, may be heard over the affected lung, or there may be merely reduction of the respiratory murmur ; or, on the other hand, harsh breathing. The chest signs vary somewhat in situation and intensity as the disease progresses, but during auscultation the râles, when present, persist in spite of cough. In favourable cases the physical signs gradually disappear ; it may be found that the areas first involved have cleared before the defervescence. Whilst, as a rule, following the fall of temperature, the physical signs clear up rapidly and completely, signs of bronchitis, present before the illness, may then return. Persistence of adventitious sounds may be associated with enlargement of the bronchial glands in children, with cardiac debility in old people, while in rare instances they indicate the beginning of a pulmonary fibrosis. Reduction of respiratory murmur, with two-phase crepitations, may persist for an indefinite number of months in the lung of a child who has had broncho-pneumonia with measles or whooping-cough.

Complications.—Among the complications may be mentioned empyema, otitis media, gangrene, and abscess of the lung. The last two are relatively common in the deglutition type of the disease. These have been dealt with in connection with lobar pneumonia. Double empyema is not unknown.

Diagnosis.—1. *From Lobar Pneumonia.*—The differentiation of the rare primary broncho-

pneumonia from lobar pneumonia is difficult or impossible. The other variety of broncho-pneumonia differs from lobar pneumonia in not being a primary condition, in its insidious onset without pleurisy, in the character and course of the temperature with its fall by lysis, and in the absence of rusty sputum. As a rule it is a bilateral affection, while lobar pneumonia is usually unilateral.

2. *From Bronchitis.*—Broncho-pneumonia may be differentiated by the greater gravity of the patient's condition, the higher temperature, the rate and character of the respiration, and the persistent and localised character of the chest signs. The point at which a bronchitis of the smaller tubes passes into a broncho-pneumonia is difficult to determine, so that for practical purposes capillary bronchitis and broncho-pneumonia may be regarded as synonymous.

3. *From Tuberculosis.*—Where both apices are affected by broncho-pneumonia, the condition may simulate bilateral tuberculosis. But in the great majority of cases of broncho-pneumonia, the signs are most marked over the lower lobes, which is very uncommon in phthisis. When, in a case of broncho-pneumonia, the temperature and other symptoms persist after four weeks, we should remember the possibility that the broncho-pneumonia is tuberculous, and the sputum should be examined for tubercle bacilli. An apparently primary broncho-pneumonia in an adult should always be regarded with suspicion. In children, where no sputum is available for examination,

the demonstration of acid-fast bacilli in the fæces should not be regarded as proof that the lung condition is tuberculous. The persistence of adventitious sounds in children who have had broncho-pneumonia often leads to a wrong diagnosis of pulmonary tuberculosis.

Prognosis.—In the primary broncho-pneumonia of children the mortality is low. Aspiration and other forms of septic pneumonia have a very high death-rate. In the ordinary type of secondary broncho-pneumonia the mortality in children under five varies from 10 to 50 per cent., being highest in infants. Broncho-pneumonia, as a complication of hæmorrhagic measles or smallpox, is very fatal. The previous health is obviously important in prognosis, and children who are debilitated from rickets or exhausted from a bad attack of measles or whooping-cough usually suffer severely. In the individual case a very high temperature is unfavourable, and the outlook is also not good where a distinctly low temperature is found accompanying extensive chest signs. Where toxæmia is marked, the outlook is correspondingly poor. Cyanosis is an unfavourable sign, as also is a toxic pallor of the face, accompanied by cyanosis of the lips. Vomiting and diarrhœa are unfavourable. Severe nervous symptoms and an excessively rapid pulse are found in cases who are gravely ill. In cases doing badly there is marked inspiratory retraction of the lower ribs. Cough becomes less, and the expiratory grunt disappears. The chest signs become more widespread and moister in

character, indicating the accumulation of secretion in the bronchial tubes. Evidence of cardiac failure may be found in a weakening of the heart sounds, especially of the pulmonic second and the mitral first, associated with marked lowering of the blood pressure. Increasing difficulty in getting the child to take its nourishment or drinks is to be looked upon as a bad sign, and the same is true of the development, later on in the case, of undue drowsiness or undue wakefulness.

Treatment.—Most of what has been written on the treatment of lobar pneumonia applies here. A temperature of 65° F. will usually be found suitable. As in lobar pneumonia, good nursing and a plentiful supply of fresh air are prime necessities. The patient's position should be changed at intervals. The diet should be largely fluid, as in lobar pneumonia, and, in young children, it should consist mainly of milk. Water should be given freely. In some cases moist heat from a bronchitis kettle, or in hospital from a high-pressure steampipe, may give relief. Friar's balsam, in a strength of 1 drachm to a pint, may be added to the water in the kettle, or may be mingled with the steam by means of a funnel attached near the outlet of the pipe. Vaporisers of creosote or other coal-tar products form a useful alternative. In prescribing hot applications externally we should remember that it is unwise to place a heavy poultice on the front of a child's chest, as this definitely increases the work of the heart. In severe cases alcohol is valuable, and signs of heart failure—a

danger which is as important here as in lobar pneumonia—should be met by the use of the drugs recommended in the latter disease. Where there is much respiratory distress an expectorant mixture may be prescribed such as the following :

℞ Syrup. scillæ
Syrup. tolut., aa. ℥ xxx.
Vin. ipecac., ℥ v.
Aq. anisi, ad dr. ii.
Four hourly (in children).

℞ Ammon. carb., gr. v.
Tr. scillæ, ℥ x.
Vin. ipecac., ℥ x.
Syr. tolut., ℥ xxx.
Aq. chlor., ad ½ oz.
Four hourly (in adults).

Belladonna is often a useful addition to such mixtures, especially when a spasmodic element is present. In adults, a small dose of iodide of potassium often does good. In septic cases in adults the combination of iodide of potassium with creosote is sometimes useful. We have found the following a satisfactory formula :

℞ Pot. iod., gr. v.
Ammon. carb., gr. v.
Creosot., ℥ ii.
Tr. scillæ, ℥ x.
Inf. senegæ, ad 1 oz.
Fiat mist.
Four hourly.

Prophylaxis.—In children suffering from measles or whooping-cough every effort should be made to prevent the onset of broncho-pneumonia. Pro-

tection from chills, attention to the hygiene of the mouth, the giving of a large dose of ipecacuanha wine as an emetic if the tubes appear to be clogged, are among the measures which may be employed in addition to those directed to the patient's general condition, and the action of the heart.

During convalescence the primary condition should be attended to, *e.g.*, rickets in children.

FIBROSIS OF THE LUNGS, OR CHRONIC INTERSTITIAL PNEUMONIA

Increase in fibrous tissue is found in many lung diseases. It occurs to some extent as a senile change, and it accompanies any chronic inflammatory process in the lung tissue. It may be localised to one portion of a lung, or it may be diffused through both lungs. Only when the process is marked enough to cause definite clinical signs is the expression fibrosis of the lung employed. As met with in practice, fibrosis of the lung is commonly a secondary condition, the result of previous inflammation. It may also be found as a local effect of pressure by growth or aneurysm, or it may arise from the organisation of a pulmonary infarct. Where the fibrosis is directly due to the inhalation of irritant particles in certain occupations, the term pneumoconiosis or pneumonoconiosis is often applied. Of the diseases giving rise to pulmonary fibrosis the most common is tuberculosis, the so-called fibroid phthisis forming a typical example of this condition. In such cases the signs of disease are commonly unilateral, though involvement of the

other lung can often be demonstrated. In some instances the fibrotic process extends inwards from the pleura, which has been the original seat of the inflammation. In others the process begins in the fibrous tissue either round the bronchi or in the alveolar wall. The broncho-pneumonia of measles, whooping-cough, or influenza may leave behind it a fibrosis in the affected lung areas, either as a direct sequel of the inflammation or following upon a condition of collapse. We have seen that lobar pneumonia on rare occasions results in a permanently damaged lung, in which fibrosis is a prominent feature. Pulmonary syphilis, either in the congenital or in the acquired form, may also give rise to interstitial pneumonia.

Symptoms and Signs.—The symptoms depend upon the stage of the disease. In the earlier stages there is chronic cough with expectoration and some degree of exertional dyspnœa. As the process advances these symptoms become more marked, and the cough tends to become paroxysmal. Fibrosis of the lung is usually accompanied by some degree of bronchiectasis, and where cavitation is well developed, the sputum and its mode of expulsion may be typical of that condition.

In the later stages cardiac symptoms may become more prominent, owing to the increased work thrown upon the right ventricle, and death may result from gradual heart failure. Apart from pyrexia due to the primary disease, *e.g.*, tuberculosis or to complications such as bronchitis or bronchiectasis, the condition is usually afebrile.

When the disease is well established, the affected side of the chest is visibly shrunken and its respiratory excursion is much diminished. The heart is pulled towards the affected side; thus, when the right lung is involved, the apex beat may be found to the right of the sternum, while with fibrosis of the left lung it may lie in the left axilla, and cardiac pulsation may also be visible over a large area in the front of the chest in consequence of the retraction of the fibrotic lung. The percussion note is impaired, often markedly so, though the dulness may be modified by the presence of tuberculous or bronchiectatic cavitation. Auscultation as a rule reveals diminution of respiratory murmur and the presence of râles or rhonchi. When the pleura is much thickened the respiratory murmur may not be audible. The opposite lung usually shows some degree of compensatory emphysema.

The **diagnosis** of chronic interstitial pneumonia is usually easy, being suggested by the appearance of the chest on inspection. The primary cause of the condition should be sought for and the possibility of tuberculosis especially should be carefully considered. Repeated examinations of the sputum for tubercle bacilli should be made, and if these are negative, the question of inoculation tests should be raised. The true nature of the fibrosis may be suggested by the previous history of the patient, which is thus of great diagnostic importance. Thus broncho-pneumonia in childhood occasionally leaves behind it a permanently damaged and fibrotic

lung, a condition which often leads to an erroneous diagnosis of phthisis.

If the apex of the opposite lung is affected as shown by clinical or X-ray evidence, the case is probably one of tuberculosis. Where the bronchiectatic features are prominent, a diagnosis of bronchiectasis may be made. It should be remembered that bronchiectasis is usually accompanied by some degree of fibrosis, and conversely fibrosis often leads to the development of bronchiectasis, so that the diagnosis may depend upon which is the more prominent feature.

Prognosis.—Fibrosis of the lung is a chronic progressive process, which permits of many years of reasonably active life. Fibroid phthisis, for instance, has a much longer duration than the common ulcerative type of pulmonary tuberculosis. Where bronchiectasis is marked, the outlook is less favourable. Death is usually due to cardiac failure, though it may result from gangrene of the lung, acute pneumonia, hæmoptysis, or one of the graver complications of bronchiectasis. Sometimes the appearance of amyloid disease precedes a fatal issue.

Treatment.—Climatic, hygienic, and drug treatment are practically those of chronic bronchitis. In fibroid phthisis the treatment is that of tuberculosis. Bronchiectatic cavities, if present, may demand special attention.

PNEUMOCONIOSIS

This is a chronic interstitial fibrosis involving both lungs, and found in those who work in atmospheres charged with dust particles of various kinds. In all

probability the particles enter the lung by direct inhalation, which, if long continued, leads to a progressive fibrosis in the lung tissue. Different names have been applied to this condition, according to the nature of the dust particles.

1. *Anthracosis.*—This is found in coal miners as the result of inhalation of coal particles. During life the patient may have the characteristic "black spit," and post mortem the lungs are seen to be black in colour, though marked fibrosis is unusual, since only some forms of coal dust appear to be active in the production of fibrous tissue. Cases of anthracosis rarely develop pulmonary tuberculosis, which, indeed, is uncommon in coal miners as a class.

2. *Silicosis* or *Chalicosis.*—This variety is due to the inhalation of stone dusts of various kinds and is found among gold miners, quarrymen, masons, and potters.

3. *Siderosis*, ascribed to the inhalation of metallic particles of iron, is found in steel grinders, but, in such cases, the irritation appears to be due to the stone dust from the grindstone rather than to metallic particles.

4. *Byssinosis.*—This is a fibrotic condition of the lungs said to develop in cotton mill operatives as the result of cotton dust. In many years' experience of Lancashire cotton workers neither of us has been able to make a definite diagnosis of byssinosis in any case, though the skiagrams of old mill-workers suffering from bronchitic symptoms show a combination of slight general fuzziness with accentuated root and bronchial shadows.

Symptoms and Signs.—The sympotms are very gradual in their development, and are those of bronchitis and emphysema with dyspnœa as their leading feature. The sputum is not, as a rule, characteristic, being muco-purulent and often copious, though in miners it may be black. It may occasionally be blood-stained, but hæmorrhage in larger amount suggests tuberculosis as a complication.

The physical signs may be scanty or even absent, though some degree of bronchitis and emphysema is often demonstrable on examination. The contrast between the paucity of physical signs and the extensive deposit in the lung as shown by X-ray examination, is often very striking. Cases of pneumoconiosis are prone to tuberculosis, which often develops in a stealthy manner. Its presence may be suspected only when constitutional symptoms, including pyrexia or hæmoptysis, appear, and repeated examinations of the sputum may be necessary before tubercle bacilli are found.

Treatment.—This is practically that of chronic bronchitis and emphysema. Where tuberculosis is superadded the treatment must be primarily for that disease. The prophylaxis of pneumoconiosis is obviously a matter of great importance, and in this respect working conditions nowadays are much better than they formerly were.

CHAPTER XI

PULMONARY TUBERCULOSIS

PULMONARY tuberculosis, due to invasion of the lung by the tubercle bacillus, is found in all countries, and in civilised communities is recognised as one of the great killing diseases. Its national importance may be gathered from the fact that in the year 1925 it caused 32,382 deaths in England and Wales ; especially when it is remembered that such a figure implies economic disablement in a still greater number. For many years the death-rate from tuberculosis has shown a progressive decline in this country. While it is noteworthy that this decrease was in evidence before the discovery of the specific bacillus and before administrative attention was directed particularly to the disease, it cannot be doubted that many complex factors have contributed to lessen the mortality, either by restricting foci of infection or by raising the resistance of the population. Among such factors may be mentioned improved sanitary conditions in the home and in the workshop, better diet, shorter hours of work, increase in outdoor recreations, the recognition of the infectious nature of the disease, and the means employed to limit infection both by treatment of the individual patient

and by the institutional segregation of the infectious. The adoption of compulsory notification of the disease was a step in the same direction. Different races show different degrees of immunity to the infection. The resistance of the Negro is low, that of the Jew is high, and in Britain those of Celtic extraction are more prone to the disease than others.

Ætiology.—The infective agent is the *bacillus tuberculosis*, a small non-motile organism about 3 or 4 μ long. It is often slightly curved and sometimes shows a beaded appearance. It is most easily detected after staining by the Ziehl-Neelsen method, which makes use of the fact that the bacillus is "acid-fast," *i.e.* that it retains the stain in spite of subsequent treatment by acid. A film of the thickest part of the sputum is made and dried by gentle heat. The carbol-fuchsin stain is applied for five minutes, during which the film is heated until steam arises, boiling being avoided. The film is then decolorised by washing and immersion in 20 per cent. sulphuric or hydrochloric acid until it becomes yellow. It is then washed in water until it is faintly pink. If a distinct red colour returns on washing it should be replaced in the acid for further decolorisation. Methylene blue in watery solution is now applied for half a minute to act as a counter-stain, and after being well washed in water the film is dried and mounted for examination with the oil-immersion lens. The bacilli appear as small red rods in a blue background.

There are three recognised types of the tubercle bacillus—the human, the bovine, and the avian;

but only the first two affect man. The bovine variety is responsible for many cases of "surgical" tuberculosis, especially in children, where the lymphatic glands, the bones, the meninges, or the serous membranes are involved. Pulmonary disease is practically always due to bacilli of the human type. In the acuter forms of the infection the organisms are usually present in large numbers, whereas in chronic lesions they may be difficult to demonstrate without recourse to animal inoculation.

Exposure to infection is well-nigh universal in civilised life, and the fact that only a small percentage of the population shows evidence of active disease emphasises the importance of the individual resistance. The virulence and the infecting "dose" of the bacillus must also play a significant part, though this can hardly be demonstrated in actual practice. The factors determining the resistance of the individual are not fully known, but among them the following are recognised.

1. *Heredity.*—Instances of congenital tuberculosis are so rare as to require no discussion, but the tuberculous diathesis, as distinct from tuberculous disease, appears from the work of Pearson to be definitely transmissible, a fact which points to the importance of the family history in diagnosis. Some believe that the presence of this diathesis may be suspected not only from the family history, but also from the general build and appearance of the patient. Two such types are usually described. In one the skin is thin and transparent, with prominently seen veins, and the chest is long, narrow,

and flat, so that the scapulæ are "winged"; in children of this type especially the eyelashes are long and curly, fine long hairs are present in the interscapular regions, and there may be some degree of circumoral pallor. The second type is the "scrofulous," in which the build is heavy, the complexion muddy, and the features have a coarseness which almost suggests epilepsy; in such patients the disease commonly affects the lymphatic glands in particular. In dealing with cases which conform to either of these types we should remember that their appearance and build are more often a result of the disease than a predisposing cause. Adolescents who grow rapidly and become unduly tall and thin are often in a post-tuberculous state rather than in a pre-tuberculous. The truth is that tuberculosis is found in all types of individuals and in all types of chests. Not infrequently, indeed, it develops in people of athletic build and habits.

2. *Age.*—Tuberculosis occurs at all ages, though clinical involvement of the lung tissue as distinct from the bronchial glands is relatively rare in childhood. The greatest death-rate is during the first twenty years of adult life. In old people it is commoner than is generally believed, for in them the lesion is often one of low activity, and may be masked by secondary conditions like bronchitis.

3. *Environment.*—Overcrowding, insufficient food or exercise, lack of sunlight and fresh air are important in so far as they lower vitality or bring closer together the healthy and the infected. The

most important factor in the environment is the presence of an actively infectious case.

4. *Occupation.*—Work in badly lit, ill-ventilated, or dusty surroundings tends to induce ill-health, which may take the form of pulmonary tuberculosis. Certain trades, such as steel-grinding and quarrying, which entail long-continued irritation of the lung tissue by inhaled dust, definitely predispose to phthisis.

5. *Other Diseases.*—Debility due to other diseases may favour the onset of lung disease. Thus tuberculosis may follow influenza in adults, or whooping-cough or measles in children. Chronic nephritis, hepatic cirrhosis, and diabetes are traditionally stated to predispose to tubercle. Alcohol, but especially all that alcoholism usually implies, undoubtedly favours infection. Speaking generally, heart disease is antagonistic to pulmonary tuberculosis. This is especially noteworthy in the case of mitral stenosis, a lesion which often simulates phthisis very closely. Where the cardiac condition is congenital and involves deficiency of blood in the pulmonary circuit, *e.g.*, stenosis of the pulmonary artery, tuberculosis is known to be a common and fatal complication. Among the insane, tuberculosis is unusually prevalent. Many causes contribute to this association. The general condition of such patients is often unsatisfactory ; it is more than usually difficult to recognise their lung disease in its early stages, and their careless habits tend to spread the infection. It should be noted, however, that the weedy, pale appearance of some mental

defectives may strongly suggest tubercle without any evidence of that disease being forthcoming.

6. *Pregnancy.*—Pregnancy by itself has no special tendency to induce tuberculosis, though debility following upon repeated pregnancies may do so. A phthisical woman may feel very well during her pregnancy, only to go downhill rapidly after parturition. She is unlikely to survive three confinements. Induction of abortion in a pregnant consumptive is rarely called for.

Sources of Infection.—Disease in man occurs from contact with bacilli derived from the discharges of infected human beings or cattle. Thus the commonest sources are the sputum of consumptive persons, and the milk of cows with tuberculosis of the udder. Tuberculous meat rarely, if ever, acts as a vehicle of infection.

Modes of Infection.—Congenital transmission of the disease by way of the placenta is possible, but is too rare to require further discussion. Inoculation through the skin can cause some forms of tuberculosis, but is an unimportant mode of infection. The ingestion of tubercle bacilli by the alimentary tract is a recognised cause of "surgical" tuberculosis in children fed on the milk of diseased cows. Some authorities believe that the bacilli entering by the alimentary tract may remain latent in the body for an indefinite period, and, reaching the lung by the blood stream or the lymphatics, give rise in the adult to pulmonary tuberculosis. It is generally believed, however, that the chief mode of infection is the inhalation of tubercle

bacilli into the lungs, either in the minute droplets ejected during coughing, or on dust which has been infected by tuberculous sputum. It will be seen that the mode of infection in tuberculosis of the lungs involves important problems which cannot be regarded as solved. It is possible, for instance, that disease in the adult may arise either from direct infection by an active case or from renewed activity on the part of an old focus of disease, which has remained latent for many years. The mode of infection has an obvious bearing upon the means to be adopted in attempting to control the disease. In the present state of our knowledge it is wise to regard cases of active lung disease as being possible sources of infection to adults and children alike, and this belief does not conflict with our own practical experience.

The contagiousness of tuberculosis depends upon the virulence and "dose" of the bacilli, and also upon the susceptibility of the person exposed to infection. In a civilised community the sources of infection are numerous—probably at least one in four hundred of our population suffers from tuberculosis in an active form—and some degree of susceptibility to the disease is very common. In a given patient it is often impossible to trace the source of infection, but the more carefully the "contacts" of a consumptive are examined, the more frequently will evidence of past or present tuberculosis be found. This is especially true where the home is poor and overcrowded, as, under such conditions, the path of infection is shortened

and the onset of the disease is otherwise favoured. In practice what one often finds is hereditary predisposition, as shown by the family history, together with close contact between the patient and an actively infectious case. In healthy surroundings, when the patient and the attendants are aware of the contagious nature of the disease and exercise appropriate care, the danger of infection is very small; but under other circumstances infection is frequent, and it is thus of great importance to examine thoroughly those who have been closely associated with a case of active disease. The investigation of a case of tuberculous meningitis, for instance, not infrequently leads to the detection of active lung disease in some other member of the household. It should not be forgotten that it is not always the weedy or debilitated individual who contracts tuberculosis, and that the disease often attacks those who have previously been robust and athletic. This supports the belief that susceptibility to infection is a specific weakness rather than a condition of general debility.

FORMS OF PULMONARY TUBERCULOSIS

The forms of the lung affection may conveniently be classified as follows :

I. Acute miliary tuberculosis of the lungs.
II. Acute pneumonic tuberculosis.
III. Acute broncho-pneumonic phthisis.
IV. Chronic pulmonary tuberculosis.
V. Fibroid phthisis.
VI. Hilum tuberculosis.

I. **Acute Miliary Tuberculosis of the Lungs.**— Acute general miliary tuberculosis is due to the invasion of the blood stream by tubercle bacilli, and is therefore always secondary to some other focus of the disease. The primary lesion may have remained latent for a long period until stirred into activity by some acute infection such as influenza or measles. Acute general miliary tuberculosis, as long as it produces no localised signs, may closely resemble typhoid fever, but evidences of involvement of the meninges, lungs, or peritoneum usually appear before death.

In the variety of the generalised infection known as acute miliary tuberculosis of the lungs, pulmonary **signs and symptoms** are relatively prominent throughout and become more marked as the disease advances from its insidious beginning. The patient may be known to suffer from chronic tuberculosis in the glands, the lungs, or elsewhere, though such evidence of previous disease is not always forthcoming. The chief symptoms are dyspnœa, cyanosis, and weakness, which become progressively more obvious. A short dry cough is present and may be distressingly frequent. Where the lungs have previously been healthy, sputum is usually absent, or if any sputum is obtained examination for tubercle bacilli will be negative. Where the patient already suffers from bronchitis or chronic phthisis the sputum may be muco-purulent, purulent, or, in rare instances, rusty. It may contain tubercle bacilli derived from such an old tuberculous lesion. Pyrexia is always found. The temperature remains

in the neighbourhood of 103° F., or it shows remissions. Occasionally it is of the inverse type in which the evening record is lower than the morning. Sweating, as a rule, is not a marked feature, and hæmoptysis is uncommon. The pulse, like the breathing, is rapid, but exceptionally may be slow in comparison with the temperature. Physical examination of the lungs sometimes reveals an old focus of disease, though this is unusual. Rhonchi, which are small and of high pitch, are found all over both lungs, or, what is equally common, universal crepitations are heard. The percussion note may be somewhat hyper-resonant from acute emphysema, but as the disease involves both lungs equally this is not always demonstrable. As a rule the spleen is palpably enlarged.

Diagnosis.—Difficulties in diagnosis usually arise from the fact that the symptoms and signs of the general infection obscure those of the pulmonary localisation. These two factors, general and local, vary in different cases ; thus a patient with definite chest signs and symptoms may be able to walk about for a week or more in the earlier stages of the disease. The presence of acute miliary tuberculosis of the lungs should be suspected when cyanosis, dyspnœa, weakness, and cough, accompanied by accelerated pulse and pyrexia, are found in a patient who has previously been certainly or presumably tuberculous, and whose lungs show signs of widespread bronchitis of the smaller tubes in the form of universal fine piping rhonchi or medium-sized crepitations. Enlargement of the spleen should

be looked for as a corroborative sign. Pneumonia can usually be excluded by the insidious onset of the symptoms, the character of the sputum, and the absence of signs of massive consolidation. Typhoid fever may be differentiated by its relatively slow pulse, its leucopenia, and by the fact that the Widal reaction is positive after the first week. Simple bronchitis of the degree indicated by the chest signs does not cause the weakness, the cyanosis, and the acceleration of the pulse and breathing which are characteristic of the acute tuberculous infection. In cases of doubt a skiagram should always be taken, when the presence of miliary tuberculosis in its more advanced phase is revealed by numerous small discrete opacities spread over the whole of both lungs.

The prognosis is bad, death occurring within two months as a rule. Symptoms of meningitis may appear at any time during the course of the disease. Treatment is symptomatic.

II. **Acute Pneumonic Tuberculosis.** — Acute pneumonic phthisis is a very rare variety of pulmonary tuberculosis. Its early stages closely resemble lobar pneumonia. The onset is sudden and marked by a rigor, pleuritic pain, and a rapidly rising temperature. As a rule the true nature of the infection is suspected only when the crisis fails to appear, the temperature persisting and assuming a hectic character. Profuse sweatings now appear, and the physical signs of consolidation, instead of clearing up, begin to indicate the breaking down of lung tissue. By this time tubercle bacilli may be

attacked by the more virulent species. They may be found in the earlier stage of the disease when the sputum is still scanty, if the presence of tuberculosis in some organ, especially if the lung has previously been the seat of an active form of disease.

The outlook is bad. The patient becomes more wasted and feeble, and as a rule dies within two months. In rare instances the disease may quiesce, and pass into a more chronic form.

Treatment is symptomatic.

(3) *Acute Broncho-Pneumonic Phthisis* ("Galloping Consumption").—The relatively benignant variety of the disease seems to originate and to advance in one who is not only already the subject of tuberculosis in the patient may be already suffering from patches of the ordinary chronic type. In the adult there may be a history of previous attacks, or of a recent attack of "influenza," a diagnosis which sometimes receives an unusually abrupt proof of the disease. In children acute broncho-pneumonic patches may follow measles or whooping-cough.

Symptoms and Signs.—The onset may be sudden, marked by marked pneumonic symptoms, or the symptoms may develop gradually, but once established, the disease runs a rapid course and is usually fatal within two months.

Pyrexia and increase in the pulse and respiration rates accompany marked constitutional symptoms. The temperature is high—103 or more in the evening—and shows marked remissions. It soon becomes hectic in type and the fluctuations are accompanied by heavy sweats. Cough is troublesome and is

attended by an increasing amount of sputum, which at first is mucopurulent but later becomes purulent and nummular. There may be hæmoptysis, but this is rarely profuse. The general condition deteriorates rapidly, with marked prostration, loss of flesh, and a tendency to delirium or even to the typhoid state. The appetite is lost and there may be vomiting or diarrhœa. Physical examination may reveal signs of a chronic lung lesion in addition to those of bronchitis. Later we may detect small areas of consolidation characterised by impairment of the percussion note and persistent crepitations. Over such areas the respiratory murmur may be diminished at first and become tubular as the disease advances, while pleuritic friction can sometimes be heard in the neighbourhood. As softening proceeds, the râles become coarser and more fluid, and, if the patient lives long enough, evidence of cavitation may be found. The signs may involve one lung or both, and they may predominate at the apex or at the base, but involvement of both lungs can often be determined, and may be confirmed by X-ray examination where such examination is safe.

Diagnosis.—This depends upon the history, the physical signs of bronchitis or broncho-pneumonia, the marked constitutional disturbance, and the demonstration of tubercle bacilli—usually in large numbers—in the sputum. The onset of bronchitis in a consumptive who has not previously been bronchitic should be regarded with suspicion, especially when the general symptoms are disproportionately striking. In such a patient the

beginning of the acute affection may be preceded by an attack of hæmoptysis which has served to disseminate the bacilli throughout the lungs. In all cases of apparently primary broncho-pneumonia in adults, the possibility of tuberculosis should be considered and the sputum examined for tubercle bacilli. The diagnosis of acute phthisis in children is usually difficult, since no sputum is available for examination and the true nature of the broncho-pneumonia may be overlooked or discovered only post mortem.

It should be remembered that, as a general rule, the lesions in the more chronic forms of pulmonary tuberculosis tend to show a broncho-pneumonic distribution in the areas in which they are found, and, especially in adolescent cases, a bilateral broncho-pneumonic spread is often apparent in the skiagram. We cannot, therefore, diagnose acute broncho-pneumonic phthisis from the skiagram alone, but must be guided by the symptoms and the progress of the case. We have seen that the prognosis is bad except in the occasional cases in which the disease passes into the chronic form. Treatment is symptomatic.

IV. **Chronic Pulmonary Tuberculosis.** — This variety of the disease is the one which is commonly met with in practice, all other forms being relatively rare. The manifold symptoms which are found in incipient cases may conveniently be grouped under four modes of onset.

1. *Insidious.*—Here there is a gradual decline in the general health, including loss of energy, loss of

flesh, loss of colour, and loss of appetite. These symptoms may exist for some time before any cough or expectoration is noticed, for they are evidences of a general toxæmia rather than of a pulmonary lesion. They are not equally prominent in any given case, and the complaint may be, for instance, only of "tiredness," "anæmia," or "dyspepsia." Careful inquiry will often elicit the fact that there is some slight cough, described perhaps as a mere clearing of the throat, especially in the morning. Even at this early stage of the disease some degree of exertional dyspnœa or an occasional night sweat may be discovered. In female patients amenorrhœa is a common and very significant symptom.

2. *Catarrhal.*—In this common mode of onset the patient may complain of an obstinate cold, "one cold on the top of another," or a bad attack of "bronchitis," "influenza," or "congestion of the lungs." Treatment has proved unsatisfactory, and he has become run down in health. In addition to cough and expectoration there may be some degree of laryngeal catarrh, as indicated by slight hoarseness or by some impairment of the speaking or singing voice. In many cases it will be found that the appearance of chest symptoms has been preceded by an indefinite period of vague ill-health.

3. *With Hœmoptysis.*—In these cases the first symptom complained of is hæmoptysis, varying from streaks in the sputum to a pint or more of fluid blood; sometimes the blood is raised in clots. The bleeding usually appears without any warning, and often apart from any exertion, and when the

amount of blood is great, it wells up into the mouth in a characteristic manner. Such a large hæmorrhage commonly means that the disease is of long standing, though no symptoms may have been noticed before. It should not be forgotten, however, that a large hæmoptysis may occur not only without any history of preceding illness, but also without any physical signs being detectable on subsequent examination. Such an absence of chest signs should not lead the practitioner to dismiss the possibility of tuberculosis.

4. *Pleuritic.*—In this form the disease begins as a dry pleurisy, or it may be that gradually increasing dyspnœa leads to a physical examination of the chest which reveals the presence of a large pleural effusion which has developed insidiously. It should be remembered that so-called idiopathic pleurisy is usually a manifestation of tuberculosis.

Speaking generally, the more carefully cases of pulmonary tuberculosis are investigated, the more it will become evident that the insidious mode of onset is the most common. Next most common is the catarrhal, while the pleuritic and the hæmorrhagic are distinctly less frequent.

In all cases, whatever be the mode of onset, some degree of pyrexia and tachycardia is commonly present—a fact of great diagnostic importance.

Course.—Chronic pulmonary tuberculosis is a febrile disease of long duration, presenting a great variety of symptoms, and characterised in the majority of cases by remissions of varying length. While it is convenient to recognise the above modes

of onset, it will usually be found in practice that the beginnings of the disease in an individual present symptoms from more than one of these modes, and as the condition advances, all the symptoms mentioned may be found.

Symptoms and Signs.—In very many cases the first symptom noticed by the patient is a loss of energy which he is quite unable to explain. This lassitude may be very striking, and it varies from day to day and even from hour to hour in a remarkable way. Thus he may be prostrate in the morning and become active mentally and physically towards evening; and we often hear the complaint "On some days I feel fit for anything, and on others I am fit for nothing." Hand in hand with this loss of energy there usually goes some loss of weight. Often this is obvious to every one, though sometimes the patient has not observed it. Loss of appetite, especially during the early part of the day, is frequently complained of, and the dyspeptic symptoms may be marked enough to suggest that the illness is primarily gastric, and may even raise a suspicion of ulceration. The patient may have lost colour to a noticeable degree, especially when the disease is acute, and in females menstruation may have ceased for several months. Some degree of cough is practically invariable, and sooner or later the cough is accompanied by sputum, small in amount and presenting no special characters. Sometimes the sputum is streaked with blood, or it may be that a large hæmoptysis, occurring perhaps when the patient is asleep, constitutes the first

warning of serious disease. In early phthisis heavy recurring night sweats are uncommon. There may be a complaint of feeling chilly and shivery in the evening, an indication of a rising temperature. The sharp stabbing pains of pleurisy may be the most prominent symptom, or evidence of laryngeal catarrh may be noticed. As the disease advances, both the constitutional and the chest symptoms become more marked. The patient becomes wasted and feeble, the cough becomes more troublesome and is accompanied by an increasing amount of muco-purulent sputum. When the sputum is definitely purulent it is often described as "nummular," as it forms rounded coin-like blobs in the sputum cup. Night sweats tend to become more and more severe, and, if cavitation has occurred, there may be large and repeated hæmoptyses. The appetite is very poor, digestion is inefficient, and diarrhœa may be easily provoked even apart from any intestinal ulceration. If tuberculous laryngitis develops, the voice becomes weak and husky, and if the stage of ulceration is reached there is distressing dysphagia. Throughout the course of the disease attacks of pleurisy are not uncommon. Pulmonary tuberculosis may undergo arrest, either spontaneously or in response to treatment, at almost any stage. Many persons, indeed, recover without ever having come under medical supervision. Where treatment is unsuccessful, death occurs from exhaustion or from heart failure, or from such complications as hæmoptysis, intestinal ulceration, meningitis, or pneumothorax.

Inspection may reveal nothing abnormal. In many cases there is obvious muscular wasting, especially over the thorax and the shoulder girdle. When the patient bends his head forwards this loss of muscle is sometimes well shown by the prominence of the skin over the line of the ligamentum nuchæ. The general appearance is often suggestive. It may conform to one of the phthisical types, though this is by no means the rule. Where the disease is active, the malar flush may contrast strongly with the general pallor. The finger-nails may be curved like a parrot's beak, but definite clubbing of the finger-tips is not common. Inspection of the chest may show lagging of one apex during respiration as a result of delayed expansion, but this is not easily demonstrable in the early stages of the disease. When definitely present, it usually means that the lung lesion is of long standing. The same statement applies more strongly to obvious hollowing above or below one clavicle. The skin in pulmonary tuberculosis usually presents no special characters. It may show sudaminal vesicles as a result of undue perspiration, or it may be clammy from the same cause. When sweating is combined with lack of cleanliness, the eruption known as tinea versicolor is sometimes found. A dry scurfy skin is found in some patients.

Palpation.—Palpation of the apices by the fingers, while the thumbs touch over the middle line behind, may bring out a disparity in the expansion of the two apices. In acute cases the chest muscles may be felt to be unduly excitable, while in chronic

cases they feel flaccid and atrophied. Myoidema, an expression of muscular irritability, may be demonstrated by directly tapping the chest wall with the finger-tips. Where the disease has advanced to consolidation, palpation will reveal increase of vocal fremitus over the affected area.

Percussion.—In incipient disease percussion will be negative, but by the time the patient seeks advice there is usually some impairment of the note over the site of the lesion. The dulness varies in degree. It may be hardly appreciable to hearing, yet evident as a feeling of increased resistance. Where the disease is of long standing, the dulness is usually definite, and if the pleura is much thickened the note may be so flat as to suggest tumour. The dulness due to consolidation may be obscured if there is much compensatory emphysema round the focus of disease. The percussion note over a large cavity may be almost tympanitic, and when such a cavity communicates with a bronchus heavy percussion performed during expiration may produce the sound we have already described as the *bruit de pot fêlé.* This is best heard in patients whose chest walls are thin and yielding. The presence of pleural effusion at the base may give to the note over the upper part of the lung that peculiar tympanitic character which is known as skodaic.

Various special methods of percussion have been devised in order to determine the earliest changes at the affected apex. When the lung is healthy, percussion reveals in the supra-clavicular and supra-spinous fossæ resonant fields which are continuous

above through a narrow isthmus. In disease this band of resonance is narrowed over the affected apex, and Krönig described this as a valuable sign in early phthisis. Delimitation and comparison of these apical bands of resonance is sometimes a useful procedure in a doubtful case, but in incipient disease the difference is not always easy to demonstrate; and if the disparity is marked, the disease is usually no longer in an early stage. It is, indeed, doubtful whether any special method of apical percussion is more valuable than careful comparison of the apices by percussion in the usual manner. It should be noted that in many normal chests the percussion note over the right apex is distinctly less resonant than over the left, and that a note which is normal to one chest may be abnormal when heard over another.

Auscultation.—In early phthisis there is very generally a diminution in the intensity of the breath-sounds over the site of the lesion. This is probably the most constant auscultatory finding. It is of great importance and should be sought for in every doubtful case. Occasionally the breath-sounds are increased in intensity, but in the ordinary chronic form of pulmonary tuberculosis such increased intensity usually means that the lesion has passed beyond the early stages; and the same statement applies to distinct prolongation of expiration. In younger patients, however, where the disease is relatively acute, increase in the respiratory murmur and prolongation of expiration may be found on the first examination. Adventitious sounds are usually

present by the time the patient seeks advice. They are predominantly inspiratory, though they may accompany both respiratory phases if the disease is very active or if there is much bronchial catarrh. They are fine, dry, crisp râles or crepitations and they persist in spite of repeated cough. Often they cannot be detected on quiet breathing, but if the patient is asked to cough they will be heard with the inspiration immediately following as a shower of "post-tussive crepitations." This manœuvre is of great importance and should never be omitted in the examination of a possible case of phthisis. Sometimes the modification of inspiration does not attain to the production of a definite crepitation, but the inspiratory sound strikes the ear as being jerky or granular—the so-called interrupted or cog-wheel breathing. Where this is found persistently over a localised area of the chest, especially towards an apex, it should be carefully noted; otherwise it has no significance. In some early cases there is a general catarrhal condition of the lungs with a concentration of the adventitious sounds at one apex, or râles or rhonchi may be heard over one lung or part of a lung, and may persist on repeated examination. Such a localised and persistent bronchitis should always be regarded with suspicion, especially if it involves an upper lobe. If it is accompanied by reduction of the respiratory murmur and some impairment of the percussion note, it is still more strongly suggestive of tubercle. Where the disease has progressed beyond a certain stage the vocal resonance will be found to be

increased over the lesion, and when it has produced a moderate and fairly superficial cavity the physical signs of cavitation will be found. Pleural thickening or effusion, if present, will give their characteristic signs and modify those of the underlying lesion.

In the physical examination of the lungs special attention should be given to the infra-clavicular and supra-clavicular regions in front and to the supra-spinous fossæ and their neighbourhood behind. The upper part of the axillary regions should not be neglected. The first signs of pulmonary tuberculosis usually appear in one or other of these areas.

No physical sign is pathognomonic of tuberculosis. In the past too much attention has been paid to minor disparities over the two lungs, with the result that a diagnosis of phthisis has frequently been made in healthy persons. When we consider what such a diagnosis means to the patient, it is plain that this is a very grave error. The examination of the chest is only one part of the examination of a possible case of tubercle, and the physician should be chary of making a positive diagnosis from physical signs alone without confirmation from sputum examination, skiagram, or a typical history of symptoms.

Stages.—It has long been customary to classify cases of pulmonary tuberculosis into stages, usually three in number. This division is based either on the extent of lung involved as revealed by physical examination, or upon the extent of the disease thus determined, together with the degree of constitutional disturbance. In addition, all cases are

divided into positive or negative, according as tubercle bacilli have been found to be present or absent in the sputum. The value of all such classifications is questionable. In many cases physical examination fails to reveal the actual degree of lung involvement, and prognosis depends upon so many factors that it is an individual problem for each case. The following classification has been approved by the Ministry of Health :

Class T.B. Minus.—This includes all cases in which tubercle bacilli have never at any time been demonstrated in the sputum.

Class T. B. Plus.—This includes all cases in which tubercle bacilli have at any time been demonstrated in the sputum. This class is further subdivided as follows :

Group I., cases with slight, if any, constitutional disturbance. Such cases should have no marked pyrexia or tachycardia, and constitutional symptoms should otherwise not be excessive. No serious complication should be present. The physical signs should be limited in extent. They should involve either one lobe only, and in the case of an upper lobe should not extend below the second rib anteriorly, or should not exceed an area of similar extent in any one lobe ; where both upper lobes are involved, the physical signs should not extend below the scapular spine.

Group III., cases with profound systemic disturbance or constitutional deterioration, with marked impairment of function, either local or general, and with little or no prospect of recovery.

All cases with grave complications, *e.g.*, diabetes, laryngeal or intestinal tuberculosis, should be classified in this group.

Group II. includes all cases which cannot be placed in Group I. or Group III.

It should be noted that a patient who has hitherto been classed as T.B. Minus passes into Class T.B. Plus once tubercle bacilli have been found in the sputum, and that a case which has once been placed in Class T.B. Plus cannot revert to Class T.B. Minus at any future time, in spite of repeatedly negative sputum examinations.

Complications of Pulmonary Tuberculosis.—These complications are, in the majority of instances, directly due to the activity of the tubercle bacillus. Lobar pneumonia does not appear as a direct cause of tuberculosis in a previously healthy subject, and as a complication it is also distinctly rare. Broncho-pneumonia is sometimes found, though more frequently it is simulated by an exacerbation of the tuberculous process itself, and such an increase in activity may also appear in the form of bronchitis. Muscular rheumatism is not uncommon in patients who live under sanatorium conditions, but acute rheumatism is rare. Compensatory emphysema is found over the healthy lung when the other is the seat of chronic disease with much fibrosis, and in such fibrotic lungs bronchiectasis may develop and tend to obscure the primary condition. Chronic pulmonary tuberculosis usually leads to involvement of the pleura, which may take the form of dry pleurisy, pleurisy with effusion, or pleural thicken-

ing. Empyema is rare, and usually is part of a pyo-pneumothorax.

Laryngitis is not uncommon in the later stages of the disease, and is one of the most serious of all the complications. The voice becomes husky and uncertain, and is altered in tone. As the larynx becomes more involved, there is distressing dysphagia, and cough is severe, paroxysmal, and often ineffectual. In the early stage the laryngeal mucous membrane is often anæmic ; as the disease advances infiltration and œdema are found, usually in the interarytenoid space or in the aryepiglottic folds. Ulceration follows, involving the interarytenoid space, the posterior ends of the vocal cords, and, later, the epiglottis, with much swelling and distortion of the structures affected. Primary tuberculosis of the larynx is rare, and when laryngeal symptoms are present there are usually definite signs in the chest, and the sputum practically always contains tubercle bacilli. It should be remembered that extensive laryngeal disease may alter the sounds heard during auscultation of the lungs, and thus tend to obscure the pulmonary condition. Apart from tuberculosis of the larynx, transient attacks of laryngitis are not uncommon in consumptives and may give rise to a suspicion of the graver complication. Where both the larynx and the lungs are affected, the two lesions sometimes alternate in activity.

Pneumothorax occurs in a small percentage of cases, especially in the more acute forms of the disease. It is a grave complication, and

may prove fatal in several hours, or it may lead to pyo-pneumothorax, which causes death after several weeks or months. A localised pneumothorax may develop without definite symptoms or signs. In a few cases the onset of pneumothorax definitely improves the condition of the patient by leading to arrest of the disease. This fact forms the basis of the pneumothorax treatment of pulmonary tuberculosis.

Cardio-vascular complications are not common. The heart in pulmonary tuberculosis is usually small. This is not easily demonstrable by percussion—indeed, owing to retraction of a diseased lung, the heart's impulse may be more extensive than normal—but it is shown in many skiagrams of tuberculous chests in which the narrow "tubular" heart often forms a striking feature. Heart disease, as we have seen, is uncommon in cases of phthisis. In the last stages of the disease femoral thrombosis sometimes occurs, while thrombosis of the pulmonary artery may be the immediate cause of death. Hæmoptysis may appear at any stage of the disease, and may be fatal either directly or by causing a rapid spread of the disease.

The blood pressure in tuberculous patients is usually below normal, and it is strikingly low in those rare instances where the lung lesion is complicated by tuberculosis of the suprarenals.

Complications involving the alimentary tract are important. Tuberculous ulcer of the tongue is rare, and usually involves the edge or the dorsum. It appears to be due to direct infection from the

sputum. It is a very painful condition. Fistula in ano occurs as a complication in a small percentage of cases. It may, indeed, be the first warning of disease in a phthisical subject and its presence, therefore, should always lead to a complete examination of the lungs. Tuberculosis of the intestine is found in the majority of all fatal cases of phthisis, though symptoms of intestinal involvement may not have been evident during life. The ulceration usually involves the last few feet of the ileum and the cæcum, and gives rise to colicky pains and diarrhœa which is very intractable. The stools are offensive and may contain blood, though this is usually small in amount. There may be tenderness on palpation in the right iliac fossa, and some degree of abdominal distension is not uncommon, especially if the peritoneum is also affected. Diarrhœa in a tuberculous subject is not always due to specific ulceration of the intestine, but often arises from simple intestinal catarrh, while in rarer instances it results from amyloid disease. But recurrent and increasingly troublesome diarrhœa in a case of pulmonary tuberculosis usually means that ulceration is present. Involvement of the peritoneum is sometimes overlooked, and should be suspected when the chest signs and symptoms indicate satisfactory progress while the general condition does not improve.

Nervous complications are few. The most important is tuberculous meningitis, which often appears insidiously. It is more common in younger subjects, and affects males more often than females. It gives

rise to persistent headache and vomiting, strabismus, alteration in the pulse rate and rhythm, and mental confusion and drowsiness which vary from time to time. Its presence may be confirmed by lumbar puncture, and occasionally by the detection of choroidal tubercles in the fundus of the eye.

In some advanced and hopeless cases of consumption the mental attitude is one of optimism—the so-called *spes phthisica*—but this is not a feature of the disease nowadays. Graver forms of mental disorder, such as melancholia and mania, occasionally develop.

Genito-urinary complications are not common, but are sometimes overlooked. Thus tuberculous epididymitis may not be observed until it causes troublesome symptoms. Conversely, a diagnosis of tuberculous epididymitis should always lead to a careful clinical and X-ray examination of the lungs. In pulmonary tuberculosis the urine may contain albumin, which may be due to pyrexia, amyloid disease, or toxæmic parenchymatous nephritis. It should be noted that the discovery of acid-fast bacilli, apart from the smegma bacillus, in the urine must not be taken as proof of a lesion in the genito-urinary tract in the absence of pyuria and other definite symptoms.

Skin complications are unimportant. Lupus vulgaris is occasionally seen in phthisical patients; erythema nodosum is rare.

Among the rarer complications may be mentioned arthritis, pigmentation, and amyloid disease.

Secondary infection of the lung by such organisms

as the pneumococcus, streptococcus, and the *micrococcus catarrhalis* is a complication to which are sometimes ascribed the bronchitic and febrile symptoms found in cases of phthisis.

Diagnosis.—The family history of the patient is of importance, for it may reveal a hereditary tendency to the disease or a possible source of infection. The personal history may disclose evidence of former tuberculosis ; thus there may be a record of adenitis, arthritis, or pleurisy, or of having "burst a blood vessel in the throat."

The need for early diagnosis in pulmonary tuberculosis has long been emphasised. The first evidences of the disease appear in the form of symptoms noticed by the patient, and it is by recognising and investigating such symptoms that we may hope to detect the disease in its incipient stage. Thus the chief cause of delayed diagnosis is not so much the lack of skilled physical examination as the failure to recognise the import of the symptoms and the consequent omission to examine at all. Here we would insist upon the great significance of the simple duration of the symptoms. Pulmonary tuberculosis is a chronic disease, with many and variable manifestations. If, therefore, we have treated a patient for several weeks without improvement on his part or enlightenment on ours, we ought always to think of tuberculosis of the lungs. If this were a routine matter in every consulting-room, the charge of delay in diagnosis would be much less frequently made against our profession. The first step in the diagnosis of tubercle is to know when to suspect it.

In some cases the diagnosis is obvious from the appearance and the history. When, for example, a patient tells us that for months he has been losing energy, weight, appetite, and colour, that he has developed a cough and some expectoration, that he has had pains in his side, and that he has brought up some blood and noticed some sweating, the diagnosis is plain, though such a case is not usually incipient. It is true, however, that we occasionally meet with a patient who consults us on account of hæmoptysis and who stoutly denies any other symptom; for in phthisis, as in pneumonia, the extent of the disease and the evidence of toxæmia do not always go hand in hand. When pulmonary tuberculosis has appeared insidiously it is not always easy to determine its date of onset; but if we ask the patient when he last felt well rather than when he began to feel ill, we are more likely to get a definite answer.

One great source of error is that of restricting our diagnosis to one or more of the symptoms. "Debility," for instance, whether we call it "nervous," "gastric," "anæmic," or "influenzal," is not a diagnosis, but a symptom to be explained; while to tell a man who complains of being "completely done up" that he is "thoroughly run down" is to jeopardise his chances of recovery. "Anæmia and bronchitis," "anæmia and pleurisy," "anæmia and gastritis," too often mean that tubercle is being overlooked, and the same is true of "influenza" either alone or with "bronchitis," "congestion of the lungs," "pleurisy," "gastritis," or "anæmia."

To diagnose anæmia in a consumptive female who has amenorrhœa and other anæmic symptoms may sometimes be pardonable, though it should be remembered that chlorosis is now a rare disease, and that it is not marked by loss of flesh ; but in the case of a male the diagnosis of anæmia should be made with great care, since it often serves to delay the recognition of tubercle.

We have already indicated the importance of dyspeptic and pleuritic symptoms as initial evidences of the disease. "Indigestion," "gastric catarrh," and "gastritis" on the one hand, and on the other "rheumatism" and "pleurodynia," are among the misleading diagnoses in such cases.

In any suspected case an accurate record of the temperature is of the utmost importance. The two characteristics of the phthisical temperature are its susceptibility to slight influences of a physical or psychical nature, and its persistence. Exercise will often cause a definite rise of temperature in a consumptive, and this fact is sometimes useful in diagnosis. In phthisical women the pre-menstrual rise of temperature is often well marked. The temperature should be carefully taken—most conveniently by the mouth—every four hours. It should be remembered that a normal or subnormal morning temperature is very common in phthisis, and cannot, therefore, be held to exclude that disease—an error which is not unknown in practice. The most useful diagnostic feature of the temperature in tuberculosis is its persistence, which may be very striking when other symptoms are not at all marked.

In this country obscure pyrexia of more than a fortnight's duration usually means that our diagnosis is reduced to one of three conditions, tuberculosis, obvious or concealed sepsis, and typhoid fever, the differentiation of which is not usually difficult with the aid of the laboratory and the skiagram. It has been stated that absence of temperature means absence of active disease, but this is not universally true, as an occasional case of active disease may remain apyrexial for a considerable period. In progressive tuberculosis the chart characteristically shows fever of the hectic type, the temperature reaching its highest point in the early evening, usually between five and seven o'clock. Hence, whatever record is taken, it should include one reading within this period. Another toxæmic feature which is almost as significant as pyrexia is tachycardia. This usually accompanies the pyrexia, but it is important to note that it may be found in an afebrile patient. In every case of obscure and persistent tachycardia, therefore, the question of tubercle should be raised.

The importance of careful examination of the sputum cannot be exaggerated. The patient's statement that he has none should not be accepted without inquiry, for sputum is present in almost every case of active disease of the ordinary type, and in the great majority of such cases it contains tubercle bacilli, even though other signs of the disease are not at all marked. One negative examination, of course, by no means excludes tuberculosis —"absence of proof is no proof of absence"—and

repeated examinations may be necessary before bacilli are found. But a persistently negative sputum is very strong evidence against active pulmonary tuberculosis.

We occasionally meet with a patient, usually middle-aged, whose symptoms and chest signs are not typical of tuberculosis and whose sputum reveals the presence of acid-fast bacilli in very small numbers on one occasion only and not on repeated subsequent examinations. The skiagram shows no definite evidence of lung involvement, and animal inoculation also may be negative. The disease does not behave like tuberculosis and is often suggestive rather of bronchitis, so that the prognosis is relatively good. In any large number of chest cases such patients form a small but definite group which has been regarded as exemplifying an "abortive" form of pulmonary tuberculosis.

Where sputum is scanty or apparently absent, the administration of small doses of potassium iodide for several days may yield sufficient for examination. In children with progressive disease of the lungs it is often difficult to obtain any sputum, but a specimen may sometimes be secured by swabbing the back of the throat while the child is retching or coughing.

X-ray Examination.—In all cases of doubt or difficulty a *skiagram* of the chest should be taken. It may prove that a non-tuberculous condition such as aneurysm, tumour, or bronchiectasis is the cause of the symptoms. It may serve merely to confirm the physical signs though it often demonstrates that

the lesion is much more extensive than these signs suggest. Sometimes it reveals extensive disease of both lungs when physical signs are absent or equivocal. It is especially useful in the diagnosis of early bilateral disease, for in such cases the physical signs are often ill defined and we are unable to detect any disparity between the two apices. A negative skiagram is very strong evidence indeed against pulmonary tuberculosis, but like all negative evidence it is not conclusive, for a repeatedly positive sputum and a negative skiagram are sometimes, though rarely, found together in an individual case over a period of many months. The coexistence of unequivocal physical signs and a negative skiagram is also very rare. The X-rays cannot be expected to reveal the first settling of the bacilli in the lungs, but it is generally true that by the time a patient with incipient disease feels ill enough to seek advice a skiagram will enable us to detect a lesion. The skiagram should be interpreted by the physician who has examined the case clinically, and the opinion of a radiologist who has not done so should be accepted with reserve.

The earliest X-ray evidence of pulmonary tuberculosis appears as a filmy, homogeneous shadow situated as a rule in an upper lobe above or below the clavicle or in the outer half of one of the upper intercostal spaces. As the disease advances the shadow extends and is differentiated into more or less discrete flocculent opacities which produce a characteristic "mottling." Such a mottled area is usually connected with the root region by an

irregular band of shadows. It is rare to find an early lesion confined to a lower lobe. Where the disease exemplifies the so-called "hilum spread" the constituent flakes of the mottling are more dense and more crowded in the neighbourhood of the root, and lessen in density and number towards the periphery of the lung. In advanced disease the shadows are more extensive and more pronounced, and cavitation may be revealed as rounded or oval areas of relative translucency set in an opaque field of consolidated lung. They are found usually in the upper half of the lung, and are recognised with greater certainty if they are seen to contain fluid with a horizontal surface.

Small calcified foci are frequently seen in or near the lung roots of patients who show no other evidence of disease. If the lung picture is otherwise negative too much diagnostic importance should not be attached to them, since they indicate disease which has undergone arrest.

Shadowing due to pleurisy is as a general rule homogeneous and not mottled. It is usually found over a lower lobe, but it is sometimes apical in distribution and is then very suggestive of tubercle. The costophrenic sulcus and the cardio-phrenic sulcus should always be carefully noted, as they may yield evidence of old or recent involvement of the pleura. In the region of the fissure between the upper and middle lobes of the right lung a broad band of pleural thickening is sometimes seen, or this fissure may be observed sharply to delimit the lower border of an apical pleurisy. Such an

appearance is very characteristic of tubercle in the absence of a recent history of pneumonia. Equally indicative of tubercle are the so-called "pleural rings" or "annular shadows." From their appearance and situation they are very readily mistaken for cavities, but it should be noted that the area within such a ring is not more transparent than the field outside it, and it does not at any time show the fluid contents of a cavity. Pleural effusion appears as a uniform shadow over a base; its upper level is sometimes seen to be a definite curve with its concavity upwards.

Tuberculosis affecting only the glands at the root may be recognised by unequivocal increase in size and density of the root shadows, which encroach upon the lung field from which they are clearly demarcated by their rounded borders.

The situation and the shape of the heart should always be noted. It may be pushed away from a pleural sac which contains fluid or air, or it may be dragged over towards a contracting fibrotic lung or an area of massive collapse. A contracting lesion in an upper lobe may cause the trachea and upper mediastinum to deviate towards the diseased lung. Lung shrinkage is accompanied by narrowing of the intercostal spaces. The heart in pulmonary tuberculosis is often seen to be small, narrow, and "tubular," and the presence of such a heart in a doubtful case should make one hesitate before dismissing the patient as non-tuberculous. Organic cardiac disease is attended by alteration of the normal contour of the heart; thus undue pro-

minence of the curve of the left auricle may be of diagnostic importance in the recognition of mitral stenosis.

Mistakes in the interpretation of a skiagram may result from failure to recognise as normal such shadows as those due to the female nipple and breast, the scapula, the crossing of two ribs, and ossification of the rib cartilages. A technically poor film or movement on the part of the patient is a possible source of error.

While a skiagram is valuable as a permanent record available for reference when we come to estimate the progress of the case, simple screening of the chest is often adequate to detect evidence of disease. When we wish to compare the illumination of the two lungs or to observe the action of the diaphragm, screening is essential. Relatively poor illumination of one apex, or unilateral impairment of the excursion of the diaphragm, may indicate the presence of incipient tuberculosis.

It is hazardous to attempt to estimate the activity of the disease from the X-ray appearances. As a general rule it may be said that soft, woolly mottling is suggestive of active disease, while scanty, dense, and clearly defined opacities indicate quiescence.

Certain laboratory procedures, such as the complement fixation test and the estimation of the opsonic index, have either fallen into disuse or have proved too complicated or uncertain to be of service in practice. In dealing with adult cases the tuberculin tests cannot assure us of the presence of active disease giving rise to symptoms and calling for

treatment. Some clinicians still make use of the skin test in the examination of children.

The ideal test for tuberculosis should fulfil certain definite conditions. It should respond to tuberculosis and fail to respond to all other diseases. It should indicate the presence of active disease and of active disease only. It should reveal tuberculosis before our other methods of examination can do so. And its use should be without danger to the patients. The various laboratory tests for tuberculosis will be found to fail in one or more of these respects, and careful examination of the sputum remains by far the most useful of all.

One of the most difficult problems in practice is that of excluding tuberculosis as a diagnosis in a doubtful case. This can never be done with absolute certainty, but when the following conditions are fulfilled one is usually safe in saying that there is no active disease :

1. The absence of the majority of the symptoms, including hæmoptysis, which we have described as accompanying active lung disease.

2. Absence of pyrexia and tachycardia for a period of, say, two weeks.

3. Absence of definite physical signs in the chest.

4. At least three negative sputum examinations.

5. A skiagram which is consistent with the normal.

The diagnosis of phthisis should be as early as possible. It should also be as certain as possible. It should never be made upon inadequate grounds. A good rule is never to pronounce a patient phthisical

upon evidence which you would not accept as conclusive in your own case were you the patient. Whenever possible we should endeavour to corroborate our personal opinion by an appeal to such objective evidence as a skiagram or a positive sputum result.

We have seen that it is common for tuberculosis to be diagnosed as some other affection. It is almost as common for a diagnosis of tubercle to be made when the patient is suffering from some other disease. In a series of five hundred cases in which tuberculosis had been wrongly diagnosed, the following conditions were found to be responsible for the symptoms :

Bronchitis	137
Mitral regurgitation	66
Mitral stenosis	54
Gastric affections, including ulcer	35
Gynæcological conditions	19
Cancer, including cancer of the lung	14
Arteriosclerosis	14
Asthma	11
Laryngitis	11
Nasal conditions, "cold," rheumatic affections, pneumonia, lobular and lobar	9 of each.
Spinal curvature with compression of the lung	7
Nephritis, menopause, neurasthenia, bronchiectasis, pharyngitis, hæmorrhoids with unobserved blood loss, and syphilis, including syphilis of the lung	6 of each.
Diabetes, and bleeding from nose or mouth	5 of each.
Empyema, aortic disease, and influenza	4 of each.

Pregnancy, aneurysm, locomotor ataxia, chlorosis, and exophthalmic goitre .	3 of each.
Myocarditis, emphysema, Hodgkin's disease, and epilepsy . . .	2 of each.
Neuritis, purpura, acromegaly, hepatic cirrhosis, lung abscess, and progressive muscular atrophy . . .	1 of each.

It will be seen that the great majority of these cases are included in a few comparatively common conditions. The differentiation of bronchitis from tuberculosis is not as a rule difficult, though the two diseases may co-exist, and tubercle may develop in a bronchitic chest. A case of bronchitis whose symptoms for the first time persist into summer and are attended by decline in the general health should be regarded with suspicion. In bronchitis the constitutional symptoms of phthisis are absent, dyspnœa is relatively prominent, and the chest condition tends to vary with the weather. The bronchitic chest characteristically presents rhonchi over both lungs, and râles when present are most numerous towards the bases. The apices are relatively clear, signs of consolidation are absent, and the sputum does not contain tubercle bacilli. The complaint is of cough and shortness of breath. Now the consumptive may complain of many symptoms, but among them dyspnœa and cough may not be at all prominent. In cases of heart disease the presence of tuberculosis is often suspected because of dyspnœa, bronchitis, and, it may be, hæmoptysis. A consideration of the nature of the symptoms and a careful examination of the heart usually suffice to reveal the true condition, though in mitral stenosis the lung signs, the

appearance of the patient and a history of hæmoptysis often combine to simulate phthisis very closely, especially if the murmur is ill-developed or overlooked. The co-existence of mitral stenosis and tuberculosis is very rare, and it is hardly too much to say that if the former can be definitely diagnosed the latter can be ruled out unless the sputum is shown to contain tubercle bacilli. The differentiation of hæmoptysis from hæmatemesis is not usually difficult if the history is carefully reviewed. When one is in doubt it is useful to ask the patient how long the blood persisted in the sputum. If he replies, "About three or four days," the presumption is strongly in favour of hæmoptysis. Apart from tuberculosis and heart disease, hæmoptysis may be found in such conditions as bronchiectasis, pulmonary neoplasm, and pulmonary embolism following operation, as well as in rarer lesions like gangrene and abscess. A large fatal bleeding may be due to the rupture of an aneurysm into a bronchus, while slight hæmorrhages may result from pressure upon the lung tissues by neoplasm, aneurysm, hydatid cyst, or pleural effusion. Bleeding from vessels in the throat practically never appears as a cause of hæmoptysis in any quantity beyond mere streaks. Hæmoptysis of tuberculous origin is very uncommon in children.

In female patients it is important to inquire about gynæcological conditions, for not only is amenorrhœa a frequent symptom of tuberculosis, but leucorrhœa or menorrhagia may produce

symptoms suggestive of lung disease. One occasionally suspects that the effects of masturbation can simulate tubercle in both sexes. Loss of weight due to cancer or to diabetes is sometimes erroneously ascribed to tuberculosis of the lungs. The differentiation of cancer from tubercle is usually possible if the case is carefully investigated. Where the cancer involves the lung, the physical signs are not typical of tuberculosis as a rule, and the pain and progressive dyspnœa are also uncommon in phthisis. The possibility of a primary growth elsewhere has sometimes to be thought of. The neck and axillary glands should be examined and a skiagram of the chest should be taken. Cyanosis and œdema are in favour of neoplasm as against tubercle. The routine examination of the urine for sugar and not merely for albumin will prevent our overlooking the presence of diabetes. When this disease is complicated by phthisis the lung lesion may remain unrecognised for a long time, for the pulmonary symptoms are obscured by those of the primary condition and the lung signs tend to be atypical in character and location. Any pulmonary sign in a diabetic should raise a suspicion of tuberculosis.

In the differential diagnosis of pulmonary tuberculosis it is obvious that the more carefully we consider the history and the symptoms, the more completely we examine the patient, and the more fully we avail ourselves of the data supplied by the various methods of investigating the lungs, the less is the likelihood of our falling into error.

Prognosis.—The course of the disease varies greatly in different cases, remissions of longer or shorter duration being the rule rather than the exception. It used to be said that the average patient lived for about two years, but under modern methods of treatment and with earlier diagnosis that figure should probably be doubled. Even at the present day a certain number of cases occur and recover without ever coming under medical supervision. In the absence of treatment, however, the disease is usually slowly progressive, with intervals of fairly good health during the remissions. Some cases show no response to treatment and go steadily downhill. At any time the disease may assume a more acute character, broncho-pneumonic or miliary, and prove rapidly fatal. Such complications as hæmoptysis, meningitis, or pneumothorax may cause death in a few days. In the ordinary chronic type of case where a cure is not effected, the patient becomes weaker and more wasted, the temperature continues, the chest signs extend, and death results from exhaustion or gradual heart failure with or without laryngeal or intestinal complications. In the individual patient prognosis is as a rule uncertain, and it is wise to avoid making precise statements. The age is of great importance. Generally speaking, the younger the patient the worse the outlook when there is definite evidence of involvement of the lung tissue as distinct from enlargement of the root glands. In working-class practice in this country it is uncommon for a patient under sixteen with a positive

sputum to recover. We have seen the importance of the family history; as a rule, the worse the family history the worse the prognosis. In this respect the presence of fatal disease in one or other of the parents is not so serious as such a record in the case of brothers or sisters. If, for instance, two members of a family have died from pulmonary tuberculosis in youth, the prognosis in the case of a third who shows signs of disease is usually bad; but this statement does not always hold good when the patient has passed the age of forty. The social circumstances of the patient must colour our prognosis. Where his means enable him to devote his life for as long a period as may be necessary to the treatment of his ailment, the outlook is obviously much brighter than that of a poor man who has to make many sacrifices to spend a few months in a sanatorium, and who has to return to work whether he is fit or not. When the disease is diagnosed in the earlier stages the chances of recovery are, as a rule, increased. Thus an early hæmoptysis may be advantageous by drawing attention to disease previously unsuspected. A pleuritic onset is usually regarded as relatively favourable, and this is certainly true where the pleura bears the brunt of the attack, and where the lung involvement is not great enough to yield a positive sputum. A continuously positive sputum is unfavourable; a continuously negative sputum is a good sign. Unfavourable factors in prognosis include cyanosis, persistent tachycardia or pyrexia, and persistent lack of appetite, especially

when these do not prove amenable to treatment. Complications such as laryngitis, enteritis, and pneumothorax render the outlook more serious. On the other hand, the presence of tuberculous disease in the lymphatic glands, the bones, or the epididymis often exercises a favourable influence on the pulmonary lesion, and the same is true of fistula in ano. In the absence of pleural effusion or other complications marked increase in the breathing rate often indicates an acute exacerbation of the lung disease and is therefore of serious significance. Other things being equal, the gravity of the case is proportionate to the amount of lung involved ; yet cavitation, which indicates advanced disease, often means chronicity and therefore good resistance, and is thus not wholly a bad sign. In women, marriage is a factor to be considered, involving as it does the risk of pregnancy. A phthisical woman should not marry until she has been free from all symptoms of active disease for at least two years. The same veto should apply to men also, unless in exceptional instances among the well-to-do. We have already seen that the question of race is sometimes of importance.

Akin to prognosis is the question of working capacity, and the presence of factors which adversely modify prognosis should qualify our assessment of physical fitness in a corresponding manner. When toxæmic features such as pyrexia, tachycardia, lack of appetite, etc., are present, the obvious need is for rest, and the question of work does not arise. The degree of toxæmia is of more importance than

the extent of lung involvement, for a patient with cavitation may be free from constitutional symptoms and may be able to engage in heavy labour without undue fatigue. In any case the question of return to work should not be raised until at least six months have elapsed since the beginning of treatment, and then only if progress has been satisfactory and in the absence of active symptoms. The effect of exercise should be noted, and a definite reaction to it in the form of pyrexia or exhaustion should be taken to mean unfitness for work. Cough and sputum should be slight or absent, and physical signs should be absent, or such as to indicate quiescence, *e.g.*, bronchial breathing with no adventitious sounds or only a few post-tussive crepitations. A case with tubercle bacilli in the sputum can seldom be regarded as having full working capacity in ordinary industrial life ; even at the best his disability is rarely less than 50 per cent. In young persons a positive sputum usually means absence of working capacity. If the patient has been to sanatorium the problem is often simplified, for his working capacity has usually been assessed under sanatorium conditions. But fitness for " full work " under such conditions does not necessarily mean that he is able forthwith to resume his old occupation in industrial surroundings, and it is usually wise to allow a month or two to pass before he attempts to do so. Return to work should be gradual, and this often demands on the part of his employer the exercise of intelligent sympathy. The nature of his occupation should of course be

considered. Unless there are strong reasons to the contrary, it is usually wise to advise him to return to his old employment, for it is only in a few fortunate instances that "light outdoor occupation" is available without serious economic sacrifice. But the chances of his infecting others in close contact with him in indoor work should be carefully weighed. A personal letter to, or even an interview with, the employer, often proves of great service to the employé. Subjective symptoms, such as lack of energy, are notoriously difficult to appraise. A thorough examination for objective evidences of toxæmia, including a temperature and pulse record, should be made, and the physical signs should be carefully considered. The patient's character and previous behaviour should also be taken into account. As a rule, in dealing with such an incalculable disease as tuberculosis, it is wise to err on the side of caution.

Treatment.—The prevention of tuberculosis is a complex problem in public health. It touches the conditions of life in the home, the school, and the workshop, in so far as these involve overcrowding, bad ventilation, dusty atmospheres, and lack of sunlight. In the individual it demands an adequate dietary, and healthy habits of life and recreation. It calls for the provision of a milk supply derived from non-tuberculous cattle, and therefore incapable of conveying infection to the young. It requires the early diagnosis and adequate treatment of the disease in individuals, and the isolation, as far as practicable, of infectious patients at home or in

institution. Improvement in these respects has in recent times coincided with a remarkable decline in the death-rate from tuberculosis.

The systematic examination of the "contacts" of an infectious case forms a measure of increasing importance in the prevention of tuberculosis. Such contacts should be advised to report at intervals for examination, and should be kept under supervision for several years. The routine use of skiagrams in contact work is of great assistance, as it not infrequently reveals disease otherwise unsuspected.

The possibility of prophylactic vaccination against tuberculosis has led Calmette and others to treat recently born infants by the oral administration of an attenuated culture of the tubercle bacillus—the so-called B.C.G. vaccine. The results so far appear not unsatisfactory, but the method is still on trial.

It should be recognised at the outset that our means of direct attack upon the bacillus are not satisfactory, and that the main principle of treatment therefore is that of improving the patient's general health in the hope of increasing his resistance to the disease. This usually means that his whole mode of living must be carefully reviewed. In the first place he should live as much as possible in the open air, though walking or other exercise may have to be forbidden at the beginning of treatment, and carefully controlled and extended as his progress permits of it. Nowadays patients understand the value of fresh air, but the majority are unaware of the dangers of undue exercise.

If the patient is confined to his bedroom, the windows and doors should be kept open day and night except during fog. Various shelters for open-air treatment are now manufactured, and these, if properly used by an intelligent patient, are quite satisfactory. It should be impressed upon him that as long as he is warmly clad he will take no harm from exposure. The diet should be generous, but he should not be stuffed against his will, as nothing is gained by his becoming too stout. His diet should contain a relatively large proportion of fat, and a quart of milk a day may therefore be prescribed in the majority of cases. On a suitable diet a favourable case should increase in weight by about a pound a week until his best-known weight is attained or passed. The weight should be recorded at weekly intervals. The routine use of alcohol is not desirable ; spirits should be forbidden, but a glass of beer, wine, or stout may be permitted with benefit to those who are accustomed to it.

The most important agent in the treatment of pulmonary tuberculosis is rest, which should be prescribed in detail in every case. At first the patient should remain in bed until his temperature has become normal, and afterwards he should be instructed to rest before and after each meal for a period of from a half to one hour.

Recurrence of pyrexia or tachycardia demands return to bed. If there is an evening temperature it is wise for him to take his heaviest meal in the middle of the day, so that it may be well digested before the febrile period comes on. As he improves,

exercise should be prescribed in increasing amounts so long as he remains free from fever or fatigue. If cough is troublesome, or if there is any sign of laryngeal involvement, smoking should be prohibited. Where the patient is treated at home, he should have a bedroom facing south if possible, and as bare of fittings and furniture as is consistent with cheerfulness. If a separate room is not available, he should sleep in a separate bed placed with its head as far as possible from the head of any other bed. A consumptive mother should not sleep with her child, and should not be permitted to suckle her infant. Separate blankets, towels, and eating utensils should be provided. The patient should be instructed to control his cough as far as possible, and to hold a handkerchief before his mouth when coughing. The danger lies in the sputum, which should be carefully burnt, and the sputum cup should be disinfected by boiling ; or cups of compressed paper may be used and afterwards burnt. Where this is not possible, the sputum should be sterilised by mixing with equal parts of some strong antiseptic, such as 1–20 carbolic acid or 1–100 izal, before being emptied into the water-closet. An ambulant positive case should be instructed to carry a sputum flask.

In all cases the patient should be overhauled with a view to getting the greatest possible benefit from treatment. In particular, oral sepsis should be looked for, carious teeth being extracted or stopped, and pyorrhœa treated appropriately if present. For the majority of patients, especially

those in the earlier stages of the disease, a prolonged residence in a sanatorium is the most hopeful course to advise. The basis of sanatorium treatment is life in the open air, in healthy surroundings, where rest and exercise are carefully controlled. On admission the patient is put to bed until the temperature remains normal. Afterwards he is allowed increasing periods and amounts of exercise so long as he remains afebrile, until in favourable instances he is able to undertake work of a more or less laborious nature without showing any reaction. It should be impressed upon him that he ought to stay in sanatorium for a lengthy period ; it is usually wise to tell a working man to stay as long as he can afford to stay. It is a mistake to tell any early case that two months in a sanatorium will put him right. Where, owing to temperamental or financial reasons, he cannot remain long enough to be set on the way to recovery, he ought at least to have learned the details of proper living so essential for the treatment of his disease. While it is obvious that an early case has as a rule a better chance of recovery than one whose true condition is not diagnosed until the disease is advanced, it should be remembered that many so-called advanced cases improve remarkably under sanatorium conditions ; and, apart from the benefit to such patients, sanatoria perform a very useful function in isolating infectious cases from the general population. This consideration is especially important where the patient's surroundings at home or at work are such as to favour the spread of infection. For

more advanced cases, however, treatment at home on sanatorium lines is often the only available course; yet where possible, both for their own sake and for the sake of others, they should be given the chance of treatment at a pulmonary hospital, *i.e.*, a sanatorium with special facilities for nursing and treating advanced and relatively helpless cases. Before a patient enters a sanatorium, the nature and aims of the treatment should be fully explained to him, and he should be instructed to obey the rules of the institution in every detail in order to derive the fullest benefit from his stay. After leaving sanatorium he should be kept under observation and examined at intervals during several years, even if his progress is satisfactory.

In many districts the services of an After-Care Committee are available to assist him in keeping fit. In some instances it may be possible for him to settle in a tuberculosis colony, and to engage permanently in more or less remunerative occupation. Before advising such a course, we should consider carefully the character and temperament of the patient as well as his physical condition.

Sanatorium treatment implies a temporary change of surroundings. A change of climate for a longer period is often desirable when the patient's means permit of it. In this country the favourite residential resorts for consumptives are on the south coast, *e.g.*, Bournemouth, Eastbourne, Torquay, and the east and south-east coasts of the Isle of Wight. For many cases an inland district of moderate altitude is well fitted; among such may be

mentioned the New Forest, the Mendip Hills, Deeside, and the higher grounds of Westmoreland and Derbyshire. It is often difficult to advise the individual patient, but it is usually safe to send him to a district in which he has found benefit when in health. In other cases we may prescribe residence in the neighbourhood of a sanatorium, where it may be possible to have the benefit of supervision by the sanatorium staff. For those who can afford it, treatment in the Swiss Alps is much to be recommended, as the equable temperature, the maximum sunshine, and the dryness and purity of the atmosphere add greatly to the value of outdoor treatment. Favourite resorts are Davos, Arosa, and Montana. In such places progress is often more rapid than at home, especially in the winter months. It is a grave mistake to send abroad advanced or debilitated cases. A sea voyage is a recommendation which should never be lightly made in view of its obvious risks.

Special Methods of Treatment. — 1. *Specific Treatment.*—The treatment of pulmonary tuberculosis by tuberculin in various forms and doses has been on trial for over a quarter of a century, and has won at the most a very qualified approval. It has now largely fallen into disuse. Its use should be confined to afebrile cases in which the lesion is limited, and in which the patient does not respond to ordinary therapeutic measures. The initial dose of tuberculin should be small, *e.g.* 0·000001 c.c. of B.E. (bacillary emulsion), which is one of the preparations most frequently used. The

patient should be carefully observed, and the dose should be gradually increased up to, say, 0·1 c.c. so long as febrile reactions are absent. The injections are given subcutaneously at weekly or fortnightly intervals.

2. *Heliotherapy*.—Treatment by artificial sunlight is at present on trial. Where the lesions are confined to the hilum or the pleura and the sputum is free from tubercle bacilli, carefully regulated exposures are sometimes definitely beneficial. Actively febrile cases with a positive sputum are regarded as unsuitable for this form of treatment, which may do them distinct harm. When sunlight treatment is considered advisable, the initial exposure should be short and the patient should be kept under observation. Haphazard sunlight treatment is definitely dangerous.

3. *Artificial Pneumothorax*.—The treatment of pulmonary tuberculosis by the artificial induction of pneumothorax is based upon the fact that pneumothorax occurring spontaneously during the course of the disease sometimes proves markedly beneficial. At present this method of treatment is employed only in certain types of cases :

(i) Where the disease is confined to one lung, especially when the response to ordinary treatment has been unsatisfactory.

(ii) Where repeated large hæmoptyses threaten to prove directly fatal and the source of the bleeding is known.

(iii) Cases of recurrent small hæmoptyses which have proved intractable to other measures.

This form of treatment is contra-indicated where there is active disease in both lungs, unless the involvement of one lung is very slight ; where the lung lesion is complicated by active disease of the intestines or larynx ; where the patient also suffers from severe organic disease, *e.g.*, diabetes, chronic endocarditis, or chronic nephritis. If the pleura over the affected lung is adherent, artificial pneumothorax obviously cannot be secured. The aim of treatment is to compress the affected lung and throw it out of action, the collapse being brought about gradually by the repeated introduction of small amounts of air into the pleural cavity at increasing intervals of time. At the first operation about 300 c.c. of air are introduced, and in the absence of reaction the first refill is given at a convenient interval, *e.g.*, a week. As the treatment continues the intervals are lengthened. The amount of air introduced at each refill should be such as to raise the intrapleural pressure by 2 or 3 c.c. of water, and the final positive pressure should not exceed 10 c.c. Some workers shorten the procedure by refilling at intervals measured by days, and so attain the desired degree of collapse in about a fortnight. The treatment should extend over a period of two or three years, and should be controlled throughout by repeated X-ray examination. It is usually most convenient to begin the treatment when the patient is resident in an institution. Serious accidents during treatment are uncommon if the technique is careful. A certain degree of pleural shock is not infrequent at the first induction. In

a large percentage of cases pleurisy with effusion develops ; it usually calls for no special treatment, but if it causes symptoms it should be aspirated and an air replacement done at the same time. Other complications include air embolism, subcutaneous emphysema, and puncture of the lung. Rupture of the lung with resulting pyo-pneumothorax is a serious complication.

Drug Treatment.—Nowadays drugs play a comparatively small rôle in the treatment of tuberculosis. They may be employed (*a*) as general tonics ; or (*b*) in the treatment of symptoms.

(*a*) Among the drugs used to improve the general nutrition of the patient the most common is cod-liver oil. It is rather a food than a medicine, its most useful function being to supplement the fat content of the dietary. It is a mistake to give it in large doses, or to force it upon a patient to whom it is distasteful, and it should not be given to cases with definite pyrexia. Its continued use is apt to cause nausea, especially in the summer months. The initial dose should be 1 drachm, which may be doubled if well borne. It may be found more palatable when combined with malt extract, but the proportions of oil and malt in the mixture should be known, as some of the cheaper preparations contain too little oil. Cod-liver oil is also traditionally combined with the hypophosphites, which are believed to improve the digestive functions and to allay cough. The active principle of cod-liver oil may now be had in concentrated form as tablets or elixir. Creosote is still regarded by many as a

useful drug. It probably does not act directly upon the tuberculous lesion, but it may help to limit or prevent secondary infection. It may be given in capsules or by a Yeo's inhaler, or may be prescribed in some relatively palatable form such as Famel's syrup. Emulsions of petroleum with or without hypophosphites are much employed in tuberculous conditions, and may prove of service where cod-liver oil is badly borne. Preparations containing calcium, such as collosal calcium, syrupus calcis lactophosphatis, etc., may be employed as tonics, and in some cases seem to hasten the process of calcification round a tuberculous focus. Within the past few years certain workers have reported somewhat promising results from injections of sanocrysin, a gold compound which is still on trial, and the use of which is not free from danger. The general drug treatment of pulmonary tuberculosis will be seen to be only of ancillary importance. There is no sovereign remedy for the disease. Every now and then some new drug, vaccine, or serum, is credited with striking curative powers ; soon it is found to be of value only in " a certain group of cases " ; finally it is relegated to the limbo of forgotten " cures."

(*b*) *Symptomatic Treatment.*—It should be emphasised that the more closely the patient's surroundings approximate to sanatorium conditions the less frequently will his symptoms call for special treatment. Among the symptoms which may demand attention the following are the commonest :

1. *Anæmia.* — Where anæmic symptoms are prominent, arsenic, in the form of Fowler's solution,

is more effective than iron. Arsenic, indeed, is a good general tonic in pulmonary tuberculosis.

2. *Dyspepsia.*—This may be aggravated by overfeeding or by unpalatable drugs like cod-liver oil or creosote. The condition of the alimentary tract and the diet should be carefully considered. Where the dyspepsia is an expression of toxæmia more rest is generally indicated. A gastric tonic of gentian, soda, and nux vomica is sometimes useful.

3. *Night Sweats.*—These are not usually troublesome in the early stages of the disease, and they tend to subside under open-air conditions. When they persist to the extent of causing distress, a pill containing $\frac{1}{80}$ of a grain of atropine sulphate may be given when required, or a 3-grain pill of zinc oxide may be prescribed thrice daily. Regular sponging, a nightdress of flannelette, and frequent changes of linen tend to lessen the discomfort.

4. *Pyrexia.*—Pyrexia usually responds to adequate rest in the open air, but it sometimes proves most intractable. When it persists we should increase the periods of rest, and it may be necessary to make the rest as near "absolute rest" as possible. Antipyretics are now seldom used, but among those which may be of temporary service may be mentioned quinine, phenacetin, antipyrin, acetanilide, aspirin, pyramidon, and cryogenin. A tablet or cachet of the drug selected should be given about three hours before the maximum temperature is expected. A more rational and more useful measure in dealing with pyrexia is the regular use of tepid sponging.

5. *Cough.*—Where the disease is active a certain amount of coughing is necessary to secure the expulsion of the sputum, and treatment is demanded only when the cough is excessive or distressing. In many cases a frequent cough is largely a bad habit, and the patient should therefore be instructed to check it as much as possible. Where sleep is disturbed a sedative cough mixture may be necessary, *e.g.* :

℞ Tr. opii ammon., ℥ xx.
Tr. lavand. co., ℥ xx.
Syrup. scillæ, ℥ lxxx.
Syrup., ℥ xl.
Aq. menth. pip., ad 1 oz.
Dose ½ to 1 oz. when required.

The use of a Burney Yeo respirator with the inhalation already given (p. 118) will often serve to diminish an irritating and useless cough. It frequently happens that the cough is most troublesome during the morning hours, and is severe enough to produce vomiting. In such cases the patient should be advised to get his coughing over before taking breakfast, and for this purpose a cup of hot tea or milk (conveniently contained in a Thermos flask) should be taken before rising. It should be remembered that a cough may be aggravated by excessive smoking, or by too dry an atmosphere in the bedroom.

6. *Hæmoptysis.*—A small hæmoptysis in the early stages of the disease needs no special treatment. In the later stages a large bleeding calls for the administration of morphine, ¼ grain, hypodermically. The patient should be told that there is no immediate danger and should be encouraged

to remain calm and at rest. Ice may be given to suck. He should lie on the affected side with the head and shoulders raised. For the immediate treatment of a large hæmorrhage an inhalation of amyl nitrite should be tried. Alcohol is contra-indicated. As long as blood appears in the sputum the patient should be kept at rest in bed. Hot drinks should be avoided, the diet being cold and fluid and given in small amounts. When the bleeding has ceased a purge in the form of Epsom salts may be prescribed. Where the patient suffers from large recurrent hæmoptyses he should be warned to avoid undue exertion and to attend to the state of his bowels; and in such cases the question of artificial pneumothorax may have to be considered.

7. *Laryngitis.*—Where the disease involves the larynx the patient should be instructed to speak only in whispers or even to remain silent and to communicate with others by means of writing. The inhalation mentioned above may be prescribed. When dysphagia is distressing an insufflation of orthoform or a spray of cocaine (1 per cent.) may be employed before each meal, and the patient may find some ease during swallowing by bending over the edge of the bed and sucking up his nourishment in a fluid form through a tube. In some cases nasal feeding may have to be adopted. The local lesion may be painted with lactic acid (20 per cent.). Where the general condition is good and the pulmonary lesion is inactive more radical treatment of the larynx, *e.g.*, galvano-cauterisation, may be attempted by a laryngologist.

8. *Diarrhœa.*—Diarrhœa occurring in the course of pulmonary tuberculosis may be due to one of three causes—simple intestinal catarrh, tuberculous ulceration of the intestine, or amyloid disease. Simple intestinal catarrh is not uncommon, and may be aggravated by an ill-considered use of purgatives. Tuberculous ulceration of the intestine is the usual cause of the intractable diarrhœa often found in the later stages of phthisis. Amyloid disease of the intestine is apparently less common than formerly. As it is usually accompanied by amyloid degeneration of the liver, spleen, and kidneys, its presence as a cause of diarrhœa may be suspected when the liver and spleen are enlarged and the urine also contains albumin. Where the diarrhœa is at all marked the patient should be put to bed and kept warm. If the attack is definitely related to some dietetic indiscretion, and if this is borne out by the state of the tongue, a small dose of castor oil or calomel should first be given. If the diarrhœa persists when the bowels have been cleared out, a fluid diet should be prescribed, consisting of milk, beef tea, and the like. Hot applications to the abdomen may be used if there is pain. Where these measures fail we are probably dealing with ulceration or amyloid disease and the use of astringent drugs is indicated. The following mixture may be tried :

℞ Acid. sulph. aromat., ℥ xv.
Tr. kino, ℥ xx.
Spt. chlorof., ℥ xx.
Decoct. hæmatoxyli, ad 1 oz.
To be taken four-hourly.

An alternative mixture which may be useful is :

℞ Bismuth. carb., gr. xx.
Sodi. bicarb., gr. x.
Acid. hydrocyan. dil., ♏ ii.
Liq. morph. hydrochlor., ♏ xii.
Mucil. acac., q.s.
Aq. menth. pip., ad 1 oz.
Four-hourly, after shaking.

In more obstinate cases a starch and opium enema should be given—20 ♏ of tr. opii, in 2 oz. of starch mucilage ; or a suppository of lead acetate gr. iii. and opium gr. 1 may be tried. The following pills are also useful :

℞ Pulv. opii, gr. i.
Cupri sulphat., gr. ¼.
Ft. pil.

℞ Plumbi. acetat., gr. iii.
Pulv. opii, gr. i.
Ft. pil.

Either of these pills may be given thrice daily for a short period.

9. *Chest Pain.*—In patients under outdoor treatment pains in the chest and back are often due to muscular rheumatism. Counter-irritation with a liniment, *e.g.*, Lin. methyl. salicyl., or the application of tr. iodi, may give relief. In some cases it may be necessary to give a mixture containing 15-gr. doses of sod. salicyl. or 10-gr. acid. acetosalicyl. Occasionally muscular pains are due to cramp caused by excessive coughing, and in such cases the patient may complain of a lump coming and going on the chest wall. Pain due to pleurisy may demand counter-irritation or strapping of the side.

10. *Dyspnœa.*—In pulmonary tuberculosis dyspnœa does not often call for special treatment,

though in chronic fibroid phthisis and in acute miliary tuberculosis of the lungs it is one of the most prominent symptoms. In the ordinary form of the disease dyspnœa may become marked as a result of certain complications, such as pleural effusion or pneumothorax ; but the most common cause of dyspnœa is co-existing bronchitis, and attention to the bronchitic condition will often afford considerable relief.

V. **Fibroid Phthisis.**—This is a chronic indolent form of the disease which we have already mentioned as a variety of pulmonary fibrosis. It is characterised by a gross increase in the fibrous tissue of the diseased lung, which leads to marked contraction of the corresponding side of the chest. As compared with the ordinary chronic type of pulmonary tuberculosis, the physical signs are relatively striking and the constitutional symptoms much less prominent. The prognosis is also much more favourable, for the patient may live a fairly active life for twenty years or more. The onset is insidious, the main symptoms being dyspnœa and cough, attended by an increasing amount of mucopurulent sputum. Occasionally the disease follows an attack of pleurisy with effusion, and the fibrotic process in such cases begins at the periphery, and not in the substance of the lung. In the later stages of the disease the constitutional symptoms become much more marked, and there may be repeated large hæmoptyses. Many examinations of the sputum may be necessary before tubercle bacilli are found, and indeed they may be persistently absent, so that the true nature

of the fibrosis may be recognised only on microscopical examination of the tissues after death.

Physical examination shows marked contraction of the affected side with reduction of its respiratory excursion. The apex beat of the heart is seen and felt to be displaced in the direction of the affected lung. The percussion note is distinctly dull, though the dulness may be modified towards the apex by the presence of cavitation. Except over a cavity, the respiratory murmur is reduced as a result of pleural thickening and deficient air entry. Râles and rhonchi of various sizes are usually audible, and cavitation may be revealed by its characteristic signs. Involvement of the opposite apex may be demonstrable, a fact which sometimes proves useful in diagnosis ; a skiagram may show this involvement when the physical signs are doubtful.

The diagnosis is based upon the history of the patient, the unilateral and well-marked physical signs, the sputum examination, and the X-ray findings. We must exclude the possibility of a unilateral fibrosis due to a former attack of pneumonia, lobar or lobular. The history of the patient is therefore of great importance, though in the case of a child the pneumonia may be remembered only as a bad attack of measles or whooping-cough. It should be noted that, in children, tuberculosis involving the parenchyma of the lung is an acute disease, the course of which is too short to permit of the development of much fibrosis with subsequent contraction. A chronic unilateral condition in a child's chest, therefore, is very rarely due to tubercle.

A basal distribution of the physical signs is also a point against the diagnosis of tuberculous disease, and the same is true of the presence of saccular bronchiectasis in a lower lobe. In obscure cases we may have to consider the possibility of rarer conditions, such as syphilis of the lung in adults, or collapse associated with nasal obstruction in children. Collapse due to the pressure of an aneurysm or tumour should not be overlooked.

Treatment.—This is on the lines already laid down for the ordinary chronic variety of the disease. In view of the long duration of fibroid phthisis, special attention should be given to the prevention of bronchitis during the winter months.

VI. **Hilum Tuberculosis.**—The expression "Hilum tuberculosis" may mean either (*a*) Tuberculosis of the glands at the hilum, or (*b*) Tuberculosis of the lungs, in which the disease begins at the root and advances towards the periphery.

(*a*) Tuberculosis of the hilar glands is a common post-mortem finding, but as a clinical condition it is difficult to diagnose with any certainty. In many cases, indeed, our diagnosis is a matter of suspicion rather than demonstration. The disease is not uncommon in children but is rare in adults.

The history, the symptoms, and the appearance of the child are of more diagnostic importance than the physical examination of the chest. Loss of energy, weight, appetite, and colour, with cough, which may be paroxysmal and which is usually unattended by sputum, is the common history, and the illness may date from an attack of measles, whooping-cough,

or influenza. There may be evidence of tuberculous disease in the superficial glands or elsewhere, or there may be a history of close association with an infectious adult. Persistent pyrexia may constitute the first indication of the disease. The appearance of the child is often significant, and may conform to one of the phthisical types.

Physical examination is usually indecisive. There may be distinct prominence of the superficial chest veins anteriorly, especially on the right side, but marked pressure signs are rare. Percussion as a rule is negative, though some impairment of the percussion note is said by some writers to be appreciable in the parasternal and paravertebral regions, especially in the right interscapular space. Auscultation may reveal a difference in the respiratory murmur on the two sides of the chest. This is due to diminution of air entry on one side as a result of pressure upon a bronchus, and may be evident over a whole lung or over a lobe, according to the size of the bronchus affected. In the interscapular region and along the sides of the sternum crepitations may be audible in some cases. According to D'Espine, enlargement of the mediastinal glands may be indicated by a whispering echo following the spoken voice and heard over the dorsal spines as far down as the fifth. In normal children the echo ceases at the seventh cervical spine, though it may be audible in some cases as low as the second dorsal. Auscultation over the upper half of the manubrium sterni when the child tilts its head backwards may reveal a venous hum

which has been ascribed to pressure upon the great veins by the enlarged glands—the so-called Eustace Smith's sign. The value of these two signs has been much debated ; they do not appear to bear any constant relation to the condition of the hilar glands ; but the presence in a marked degree of one or both of these signs supports a diagnosis of glandular enlargement to which we have been led by other evidence. The most valuable method of examination is by X-rays, which may show that the hilar glands are indisputably enlarged, or may reveal deficient illumination over one lung or one lobe when the glands are pressing upon a bronchus. But we should remember that enlargement of these glands does not necessarily mean tuberculosis, and it is possible that tuberculous enlargement of the glands may not be apparent unless the disease has reached the stage of fibrosis, caseation, or calcification.

Disease of the hilar glands may lead to the development of acute miliary tuberculosis by direct invasion of a blood-vessel.

(*b*) The second variety of hilum tuberculosis is sometimes known as hilum phthisis. The earliest lesions are found in the neighbourhood of the hilum, and from there the disease advances outwards into the lung tissue. It may arise from tuberculosis of the hilar glands. This variety of the disease is not uncommon, especially in adolescent cases. The typical symptoms of active phthisis are often present, and the sputum may be found to contain tubercle bacilli. The course of the disease is often rapid, but for a long time physical signs are in-

definite. They may be first appreciable near the roots, along the sternal border, under the clavicle, or in the axilla. In such cases a skiagram will show that the foci of disease are most numerous near the root, and that they show a somewhat broncho-pneumonic spread as they advance towards the periphery. Both lungs may be seen to be involved, though this may not be apparent on physical examination until some time has elapsed.

Diagnosis.—As we have already seen, the diagnosis of tuberculous disease of the hilar glands is based upon the history, symptoms, and X-ray examination, and only to a minor degree upon physical signs. It is often arrived at by a process of exclusion. In children we have to think of such conditions as rheumatism, empyema, and septic absorption, *e.g.*, from the tonsils or the genito-urinary tract. The diagnosis of the second variety of hilum tuberculosis is based upon the typical symptoms of active tubercle, sputum examination, and the skiagram. The appearance of definite physical signs should not be waited for.

Prognosis.—In the case of the glandular affection the prognosis is good. The prognosis in the second variety of hilum tuberculosis is distinctly worse, and if the diagnosis is delayed until physical signs appear, it is, as a rule, definitely unfavourable.

The treatment of both varieties is upon the lines already laid down for the ordinary type of pulmonary tuberculosis. Where the disease is confined to the hilar glands, the careful use of heliotherapy sometimes proves of distinct value.

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